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VOLUME XIII MAY 5, 1924 NUMBER 7

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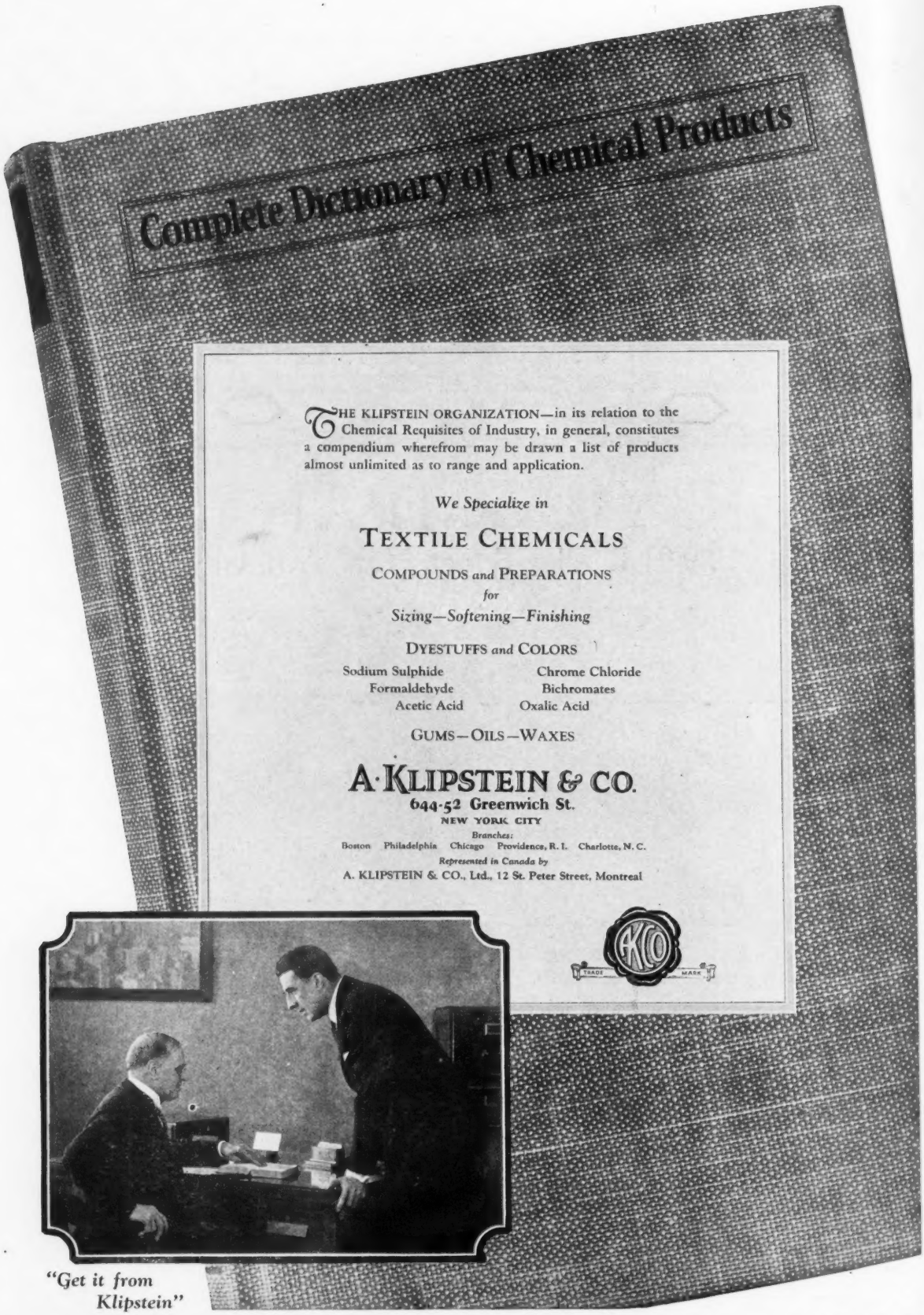
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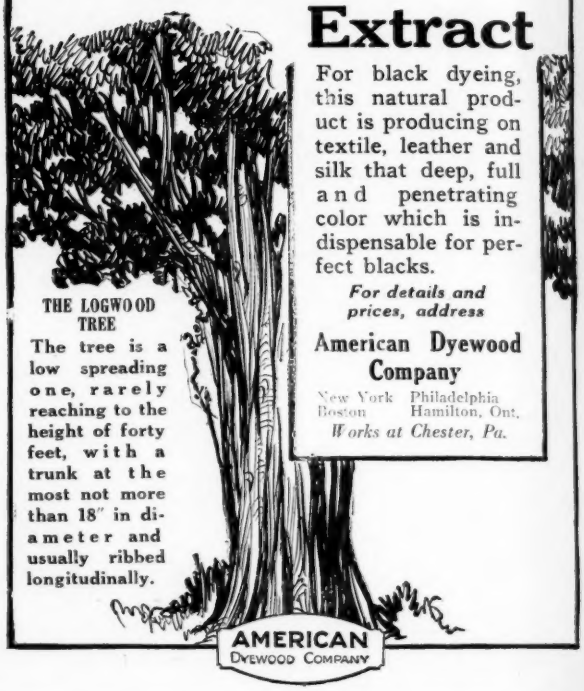

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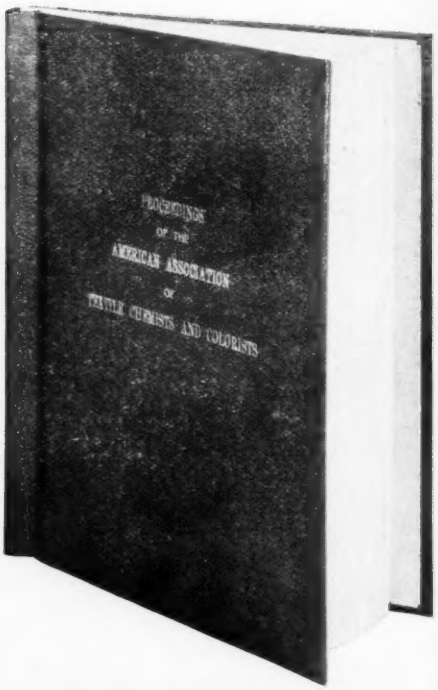

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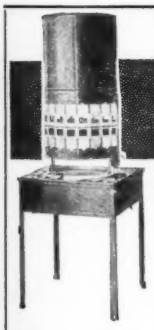

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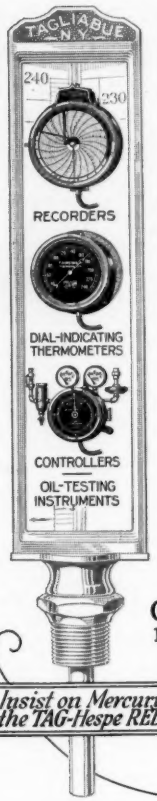

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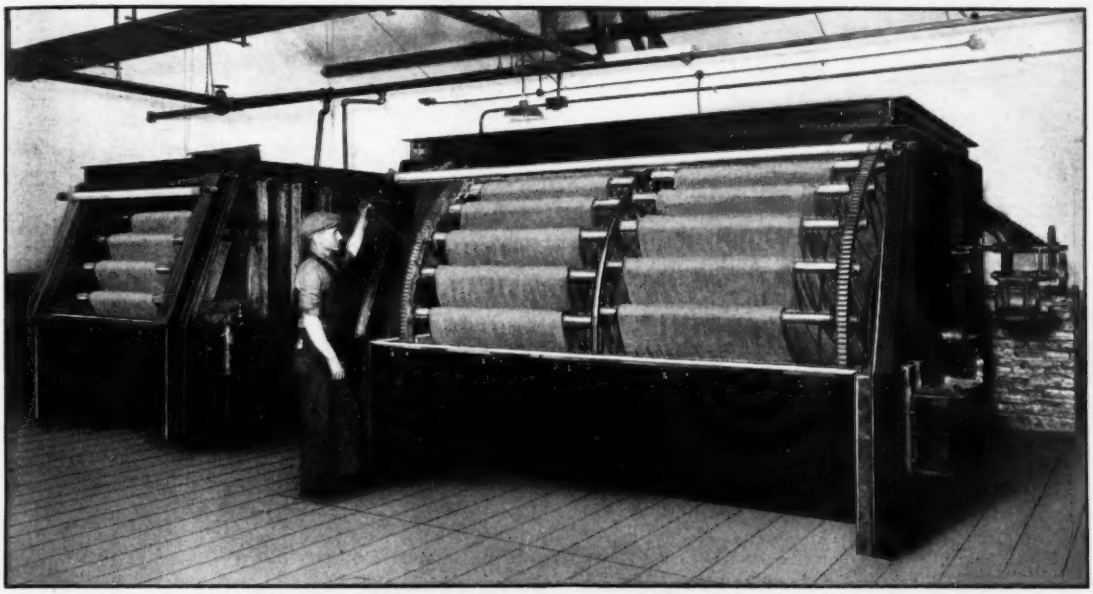

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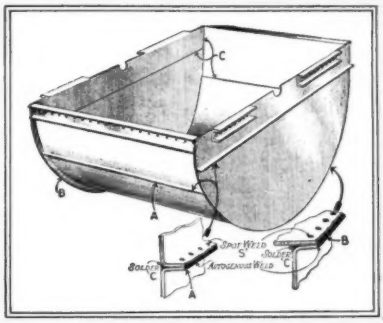

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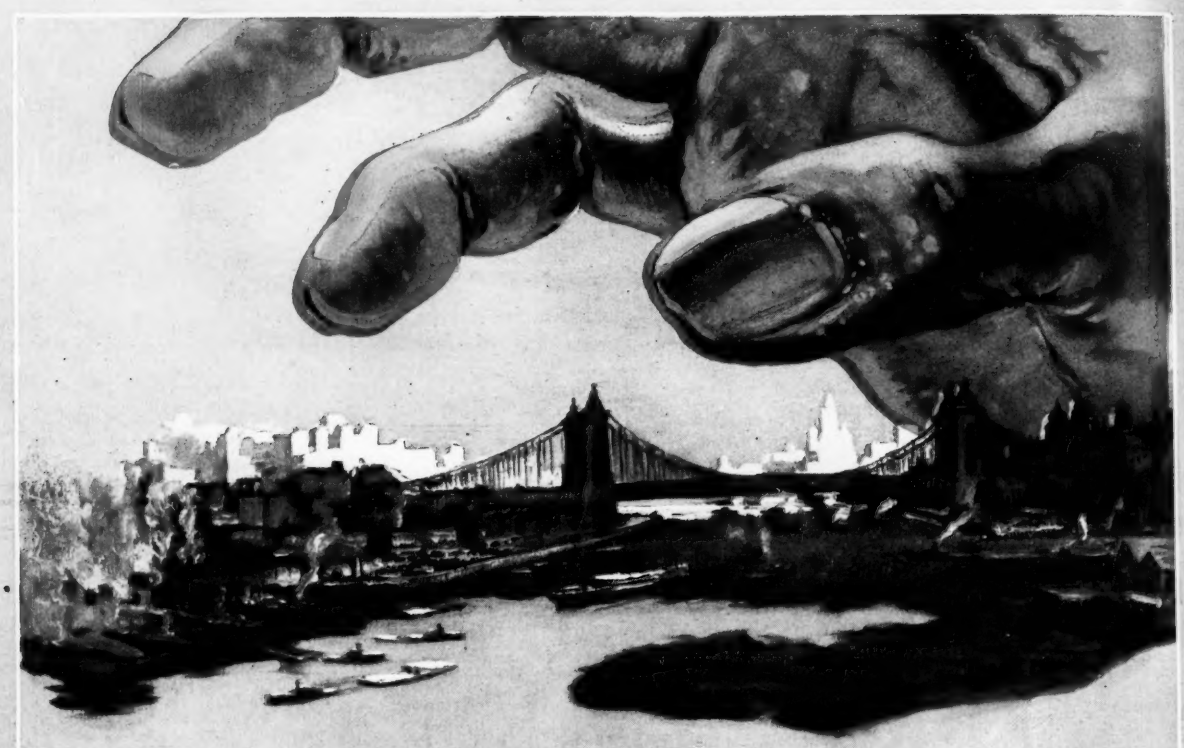

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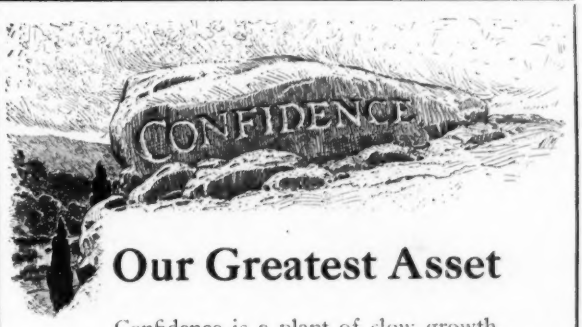

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The Chemistry of Cotton Cloth Finishing

Properties of Cotton Fiber—Two Methods of Bleaching—The Caustic Soda Process—Mercerization—Weighting Materials—Thickening and Binding Agents

By JOHN F. WARNER

General Manager, Bronx Company, New York City

THE term "finishing" in its broadest sense includes all the processes to which cotton cloth is subjected after it leaves the weaving mill. The bleaching, dyeing, printing and mercerizing of the cloth are all important factors in producing the finish. In the final analysis, it is very largely the finished appearance of the cloth which determines its selling value, or its suitability for the use for which it is intended. It is true that the final treatment of the cloth is apt to be largely a physical process rather than a chemical one. In spite of this, however, a knowledge of the properties of the materials used is essential if the "finisher" is to be able to produce uniformly the finishes required of him, as well as to work out new finishes when style trends change and new uses are found for cotton fabrics.

Of the preparatory processes, neither the dyeing nor printing exerts any appreciable effect on the final finish. The type of bleaching employed, and the degree of mercerization attained are both of great importance to the finisher, however, and it is therefore necessary to discuss them in a treatise on finishing.

Properties of Cotton Fiber

The cotton fiber in its natural state is composed largely of pure cellulose but contains as well impurities to the extent of about 4 per cent, consisting of cotton wax, pectic acid, albuminous matter, a small amount of mineral matter and coloring matter. Most of these impurities are not soluble in water and for this reason the main bleaching operations have for their object the removal of the waxy and resinous substances, so that the coloring matter may be destroyed in the subsequent treatment. In addition to the natural impurities of the cotton fiber, cotton cloth contains as well sizing materials which are necessary to the proper weaving of the fabric, and dirt and oil received in the course of manufacture. The size usually contains starch and some saponifiable fat, but often contains in addition paraffin wax and chloride of calcium or some other similar substance which will attract moisture and thus give the manufacturer a greater production through lack of broken yarn in weaving. Such chlorides are dangerous, however, because of their tendency to decompose when the cloth is heated, into free hydrochloric acid, which will quickly tender the cellulose. The paraffin wax is objectionable because of an insoluble compound formed when the cloth is acted upon by chlorine in the latter part of the bleach.

Two Methods of Bleaching

There are two principal methods of bleaching cotton cloth and each affects the final finish somewhat differently. When the finisher does not intend to dye or print the cloth but is interested chiefly in obtaining a permanent white, the so-called lime process is usually employed. This consists of saturating the cloth with calcium-hydrate of milk or lime, and then with washing, boiling with water under pressure.

The first requirement in bleaching is to saponify the fatty and waxy impurities in the cotton so that they may later be easily and thoroughly removed, and thus help in reducing the cloth to as pure a state as possible. Of the various alkalis used in this saponification, lime has been found to exert the most vigorous action. Although the lime soaps formed are likewise insoluble, they are not objectionable, because they are decomposed by weak mineral acids. The next step in bleaching following the

boiling is to wash off the excess lime and then treat the cloth with an acid solution. Hydrochloric acid is commonly used and a soluble lime soap is produced, along with some free fatty acids. After "souring," the cloth is well washed to remove the lime soap. It is then boiled again, this time with carbonate of soda containing no water of crystallization. This dissolves the fatty acids in the form of their sodium salts. After this boil, the cloth is thoroughly washed and is then ready for the second step in bleaching, the removal of the coloring matter in the cotton fiber. This is accomplished by passing the cloth through a solution of chlorinated lime, or "bleaching" powder, and again washing and souring with a weak solution of mineral acid. The action which takes place seems to be that some of the calcium hypochlorite or bleaching powder, aided by the carbonic acid in the air, decomposes and sets free hypochlorous acid, which, in turn, quickly decomposes into hydrochloric acid and nascent oxygen. The nascent oxygen thus freed immediately decolorizes the coloring matter in the cotton, and the hydrochloric acid produced again acts upon the bleaching powder, thus liberating more hypochlorous acid.

The Caustic Soda Process

The second method of bleaching is by the "caustic soda process," which consists of boiling the cloth in a solution of caustic soda. This method, because of its simplicity, is becoming of very general use, especially for dyed and printed cotton fabrics. The caustic soda saponifies the natural waxes and fats in the cotton, as well as the fats used in sizing the yarn, very readily. With this process the cloth requires but one boiling, after which it is well washed and soured as in the lime method. It is then passed through a calcium hypochlorite solution, washed, soured and given a final thorough wash. Because of the few operations used in this method the bleacher must use great care in determining the strength of the caustic soda solution. It is not common to find the strength gauged from the specific gravity of the solution, but this should not be done without checking at the same time the real quantity of caustic alkali present. The specific gravity will naturally account for dissolved impurities, regardless of their nature. Without doubt, the greater part of the finisher's troubles in producing uniform finishes with the caustic soda bleach may be traced to irregular and insufficient "bottoming" of the cloth in the boil. The lime liquor being used in a milky state thus carries along a certain reserve of lime, able to replace any lime which becomes carbonated in boiling or combined with the waxes and fats in the cloth as lime soaps. In the boil with caustic soda, unless great care is exercised to insure perfect circulation, the liquor gradually becomes weaker from contact with the cloth, and saponification takes place less vigorously on some parts of the cloth than on others. This condition will give rise to stains in the cloth and will tend to the production of an uneven dyeing and finish.

Among finishers there is a difference of opinion as to when it is most advisable to use the lime process and when to use caustic soda. Practice seems to show, however, that for cotton cloth which requires a firm finish, where large quantities of starch are used; for fabrics, which require a linen-like feel and for goods which are to be sold in the white state, the lime process gives the best results. This is no doubt due to the fact that the natural impurities are so thoroughly removed from the cotton by this process that the cloth is capable of receiving large quantities of thickening and weighting substances in the final finishing operations. The caustic soda process, on the other hand, because of its simplicity and cheapness, is used for the ordinary run of dyed and printed fabrics. Using this method, the cloth comes from the bleach with a soft, rather spongy feel. Inasmuch as the object of bleaching cotton cloths is to effect two chemical changes—saponification of natural waxes and fats and decolorization of the coloring matter in the cotton fiber, it is doubtless true that, regardless of the method used, if due care is exercised in the mechanical handling of the material, the final results will be very similar.

The second important factor affecting the finish of cotton cloth is the degree of mercerization given to it. The beauty of some of the finishes obtained by this treatment has done much toward increasing the world's consumption of cotton in recent years. Mercerization, which is so called because it was first observed by an English textile chemist, John Mercer, takes place when cotton is treated with strong solutions of cold caustic soda and then washed. The cotton contracts from 16 to 25 per cent in length and at the same time becomes denser, stronger and gains in weight from 4 to 5 per cent. The cellulose first forms a compound with the caustic soda, and this, either from washing or from contact with the carbonic acid of the air, decomposes with the production of cellulose hydrate. The commercial importance of mercerization is due to the fact that if cotton so treated is prevented by mechanical tension from contracting, a peculiar change takes place. The cotton fiber, viewed under the microscope, instead of having the appearance of a flattened, rather twisted tube, appears as a straight translucent tube with a beautiful luster. A similar result is obtained by the use of strong mineral acids, but this is not of general value in practice because of the danger to the fiber involved in the use of them. Potassium and zinc chloride, as well as several other chemicals, will also produce this result, but are not of commercial interest because of their high cost.

Value of Mercerization

The luster obtained when this process is applied to the finest grades of cotton closely approximates that of silk, and it is therefore of great value to the finisher to understand fully the conditions which influence its production. A great deal of difficulty is sometimes

met with when the goods are mercerized without any preparatory treatment. Investigation usually shows that the yarn used in the manufacture of the cloth in such cases has been heavily sized before weaving, and the strong caustic soda, acting upon the starch contained in the size, has formed a thick transparent mass which when dried has the appearance of horn. This naturally retards the action of the caustic, and the luster suffers as a result. To insure against irregular and insufficient lustering due to this condition, it is advisable to mercerize the cloth after saponification has taken place in the boiling with lime or caustic soda. By that time the starches used in sizing have been quite thoroughly removed, and the cloth is in an absorbent condition. When goods are to be mercerized which do not require bleaching, the starchy materials used in the size may be broken up by treating the cloth with a concentrated malt of high diastatic value. In this way the starch is converted into a soluble sugar which is easily removed by washing.

The principal substances used in the final finishing of cotton cloth are divided into three groups, namely: Weighting and filling materials, thickening and binding materials, and softening materials. The weighting and filling agents include barytes, the sulphate of barium; Epsom salts, the sulphate of magnesium; mineral white, the sulphate of calcium; talc, the silicate of magnesia, and china clay, the hydrated silicate of alumina. The last few years have seen the price of raw cotton rise to levels never before experienced. This, of course, has affected the cloth market in like manner, and as a result the manufacturer using cotton fabrics has in many instances called upon the finisher to produce low-grade fabrics which would have the appearance and weight of those of better grade. As a result of the lack of knowledge regarding weighting materials, many of our American finishing plants have found themselves in some cases unable to meet their customers' wishes and at other times have experienced trouble in obtaining uniform results.

China Clay

China clay, the most important of the materials used by the finisher for giving weight to cotton cloth, is a natural product resulting from the decomposition of mineral feldspar, which is brought about by the action of carbonic acid and the moisture of the atmosphere. The crude clay contains grit and mica, which must be removed before it is suitable for use in finishing. Iron, which is sometimes present, is likewise objectionable because of the possibility of iron stains being developed in the finished cloth. China clay for finishing purposes should be of a good grade. While the clay is not soluble in water, it forms, when boiled with starch and water, a smooth, opaque mixture which is of great value in filling and covering low-grade cloths. For cotton goods which require a weighting material which is soluble in water, magnesium sulphate is extensively used. It gives a harsh feel to the cloth, due to its crystalline form. To overcome this objection, magnesium chloride or some other substance of a deliquescent nature is sometimes used in conjunction with the sulphate. The use of such chlorides is not desirable, however, because of the danger of tendering the cotton by liberation of free acid when the cloth is heated.

The important fact for the finisher to bear in mind when it is necessary to add weight to cotton cloth is that china clay, barium sulphate, talc and other materials which are insoluble in water will necessarily have a dulling influence upon the appearance of the finished cotton. For this reason they are generally used only for white and printed goods, and the water-soluble materials, such as magnesium sulphate, sodium sulphate, etc., are employed on bright shades of dyed goods.

Thickening and Binding Agents

All of the weighting materials require the addition of a thickening and binding agent to be successfully applied to cotton, and some form of starch is usually used. Starch for finishing is manufactured principally from potatoes, farina, wheat, tapioca, sago and corn. Although insoluble in water, starch granules swell greatly and appear to have gone into solution, although this is not the case. The value of starch depends largely on the thickening power of its paste, although for the finisher of cotton cloth a practical trial is the only exact method of testing. The finished results obtained by the use of various starches vary greatly, and range from the thick, smooth feel given by farina starch to the thin, harsh feel produced by sago. It is customary for the finisher to mix the starches at his disposal so as to produce any degree of finish desired.

For softening the harsh effect of the starches and filling materials, fats and oils are used. Mineral oils are used to a limited extent on some kinds of black-dyed cotton cloth, but for most fabrics vegetable oils are employed. Such materials should be easily soluble in water and free from objectionable odor.

The processes used in applying the various thickening, weighting and softening materials to cotton cloth in the final finishing operations are almost purely mechanical in character. Most of them depend upon the fact that the cotton fiber in a damp state is plastic and is capable of assuming the form imparted to it by pressure. The advent of the trained chemist, with his standardized methods of control of the various finishing operations, is a comparatively late development in this branch of the textile industry. In view of the almost universal lack of knowledge regarding the chemistry of cotton goods processing and finishing, his field for research should certainly prove a fertile one.

Dyeing of Textile Fabrics with Chrome Dyestuffs

General Properties—The Four Methods of Chrome Dyeing—The Mono or Meta Chrome Method—Dyeing Mixed Fabrics—The Chrome-Mordant Method—Dyeing Silk with Acid Chrome Colors—The Chromosol Method—Some New Chrome Colors

By ISMAR GINSBERG, B.Sc., Chem. Eng.

THE chrome colors constitute a very interesting series of dyestuffs. They are known under a variety of names, the most common being "acid chrome colors," and are employed principally in the dyeing of woolen and silken fabrics, yarns and intermediate products of manufacture. This group consists of dyestuffs which can be applied directly to the wool fiber in an acid bath. The fiber is thereafter or simultaneously treated with a chromium salt to fix the dye on it. Bichromates and other salts of chromium are employed for this purpose.

The majority of colors included in this category are azo compounds. A good many of them are derivatives of salicylic acid or of ortho aminophenol. Others that may also be included in this series are derivatives of anthracene, pyrogallol, naphthalene, and a number belong to the class of tri-phenylmethane colors. The characteristic which distinguishes all these coloring matters is the fact that they are used with one or another of the common methods of fixing and developing colors on the wool and silk fiber, known as chroming.

General Properties of the Colors

The most characteristic property of the chrome colors is their extreme fastness to influences which are generally detrimental to the general run of organic dyestuffs. They resist extraordinarily well the action of light, washing, milling, acids, alkalies, rubbing, perspiration and general wear and tear. Some of the colors are also fast to acid cross-dyeing, stoving, potting or wet-steaming.

The action of the chrome salt on these dyestuffs may be of two sorts. In some cases the chromium salt oxidizes the dye, as in the case of azo rubin and the chromotrope dyestuffs. When this takes place the color of the dyestuff is materially changed. In the second case the chromium salt forms a color lake with the dyestuff, much in the manner that mordant lakes are formed. The dyestuffs that give such results are in a measure mordant dyes and it is questionable whether they should be included in this category or classed as mordant dyes.

The chrome colors are used on loose wool, tops or yarns to produce shades that are fast to milling. They are also used in dyeing suitings and other piece goods, and used in making men's clothing, which must stand considerable wear and tear.

The Four Methods of Chrome Dyeing

There are four common methods of dyeing textile fabrics with the chrome dyestuffs. The first and most simple of the methods is known as top-chroming. In this method the dyestuff is first applied to the fiber and then the mordant is added, either in the same bath as the dyestuff or in a separate bath. The top-chrome or after-chrome method is particularly well suited for dyeing woolen fabrics. The one-bath method is the more popular of the two varieties of this process, as it is the less expensive of the two. On the other hand, when using the single-bath process it is, of course, important to see that dyestuffs are employed which are easily taken up by the woolen fiber. The dye bath must be easily exhausted when it contains a chromium salt, as otherwise whatever dye does remain may be precipitated by the chromium compound. The method undoubtedly has its advantages, but it must not be forgotten that it possesses disadvantages as well. It is difficult to match colors when this method is employed, and due to the reasons given above it cannot be used with all the chrome dyes. The after-chrome or top-chrome method is also fraught with difficulties in obtaining level shades, which makes it well adapted, on the other hand, for dyeing loose wool and slubbing where level shades are not required. The method is used largely in dyeing blacks, blues and dark browns, and it gives very fast shades.

The color is first heated up with a small amount of water until a perfect solution is obtained. The dye must be well dissolved. Then the dye liquor is made up with this solution of color plus the proper amount of cold water in which anywhere from 1 to 5 per cent of acetic acid has been added. The acid should be about 30 per cent strength. The solution may also contain 10 per cent of sodium sulphate. The material enters the bath at a temperature of 40 to 60 deg. Cent. Then the bath is heated gradually to boiling and boiled for approximately one hour. During this time the bath is exhausted by the addition of 5 to 8 per cent of acetic or 1 to 4 per cent of sulphuric acid.

The dye bath is then allowed to cool off slightly and

from one-half to two-thirds of the weight of the dyestuff in a chrome salt is then added. The proportion of the chrome mordant used will, of course, depend on the depth of the shade required. The bath is then boiled once more for a period of thirty to forty-five minutes. After dyeing, the wool is washed immediately to prevent the change in color that is produced by prolonged exposure to the chrome compound. In the place of acetic acid, sulphuric acid in a proportion of from 1 to 4 per cent may be employed with certain dyestuffs with equally as good results. In other cases an 85 per cent solution of formic acid may be used. When using a dyestuff which does not resist well the oxidizing action of potassium dichromate, chromium fluoride may be used instead. There are disadvantages in employing this salt, for it does not fix the colors well and, furthermore, it gives the wool a harsh feel.

When the top-chrome method is carried out in two baths, the chrome solution is mixed with the acid. In using hard water, water containing calcium salts, it is well to treat the water first with ammonium oxalate, as certain of the acid chrome dyes are sensitive to calcium salts. Another important consideration in the use of all the chrome processes is the effect of the ingredients of the liquors on the metal of the vessels in which the dyeing is carried out.

Copper is the metal most commonly employed, and it is advised that the copper be neither polished nor cleaned, for the coating that it receives on being used diminishes in a marked degree the detrimental effect of the metal on the dyestuffs. In certain cases where the dyestuff is extremely sensitive to copper, the use of a little ammonimum sulphocyanide is recommended. A solution of one-half of 1 per cent on the weight of the goods to be dyed is made up and boiled in the copper vessel for about twenty minutes. The ammonium sulphocyanide reacts with the copper to form a film of copper sulphocyanide over the internal surface of the vessel. Then the dyestuff and the other various ingredients of the bath are added and the dyeing is carried out in the regular manner. Sulphocyanide of copper seems to have but little effect on those dyestuffs that are very sensitive to copper salts.

The Mono or Meta Chrome Method

Only one bath is used in this process and the chrome mordant is added at the beginning of the dyeing process. The process first started by using a mordant made by mixing yellow chromate with ammonium sulphate and sold as a special mordant compound. To-day every dyer make his own meta-chrome mordant. This method of mordanting the chrome colors gives very level shades and is used to a large extent in dyeing light colors. The theory of the dyeing is that the dyestuff does not precipitate the color in the cold, but, on heating, the ammonia salt is decomposed, the solution becomes acid and conditions are proper for the precipitation of the color lake on the fiber.

The color is added to the dye vat first. Then enough sulphate or acetate of ammonia is added to make a solution containing from 2.5 to 5 per cent of the ammonia salt. Then half as much chrome as dyestuff is added. The dye bath is heated to a temperature of 140 deg. Fahr. and the goods are introduced. The liquor is then slowly brought up to a boil and the dyeing is continued from one hour to one and a quarter hours. At the end the bath is exhausted by the addition of a small amount of sulphuric acid or acetic acid. Formic acid may be used in place of these acids and ammonia may be employed instead of the acetate or the sulphate. This process of chrome mordanting is well suited for use with various meta-chrome colors, various browns, reds, greens and yellows, monochrome, chromate and auto-chrome colors. Colors are easily matched by this process, which constitutes a distinct advantage over the top-chrome process.

There are several variations of the mono-chrome method, but these need not be described in detail at this point. One such process, which is said to give very satisfactory results, is to give the goods a boil with magnesium sulphate solution for fifteen minutes before the chrome compound is added.

Woolen fabrics, worsteds, are sometimes made with silk stripes. In the dyeing process it is desirable, to keep the effect of the stripe, to dye the woolen part of the fabric only and leave the silk untouched. The chrome-dyeing process can be used for this purpose. The dyeing is commenced in a hot bath to which there has been added from 5 to 10 per cent of acetic acid. After an hour's treatment, the goods are rinsed with hot water and given a chrome treatment in a fresh bath to which there has also been added approximately 7 per cent of acetic acid. This bath contains between 1 and 2 per cent of the chrome salt. When the fabric is treated by this method, the silken part of the fabric is left untouched.

The Chrome-Mordant Method

In this method the wetted goods are introduced into a bath which contains 3 per cent of bichromate of potash and the same proportion of cream of tartar. The bath is raised to the boiling point and the boiling continued for an hour. Then the goods are allowed to cool off, and after being well rinsed with water they are ready to be dyed. At the commencement of the mordanting process the wool possesses a bright yellow color, and the process is continued until the color has changed to olive green.

This process is subject to many variations, according to the nature of the dyestuff used and the effects that are desired on the fabric. In certain cases sulphuric acid and oxalic acid are added to the chrome

bath. The methods give colors that are very fast and resist all influences as well as when the other chrome treatment processes are employed. If it is desirable to obtain an extraordinary degree of fastness in the colored fabric it is necessary to add a small amount of chrome salt to the dye bath after the latter has been exhausted.

Dyeing Silk With the Acid-Chrome Colors

While the acid-chrome colors are important principally because of their use in dyeing woolen yarns and fabrics, they are also used in the dyeing of silken fabrics. They give good results; but inasmuch as silk is a much more sensitive fiber than the wool, it is more subject to injury by the chromic acid used in the methods described above. Hence it is preferable to employ such dyestuffs which do not require a strong chrome treatment to develop and fix them on the textile fiber. Furthermore, it is also necessary to select the dyes that will retain their original color after the dyed fabric has been chromed.

A general method used in dyeing silken fabric is to use a liquor that contains anywhere from 2 to 5 per cent of acetic acid, the dyeing being commenced at a temperature of 40 to 50 degrees. Later the temperature is raised to the boiling point and the dye bath is exhausted with sulphuric acid. The chrome treatment is carried out in a bath containing from 1 to 2 per cent of potassium bichromate or from 1 to 3 per cent of chromium fluoride. To this bath about 5 to 8 per cent of acetic acid is added. The silken fabric is worked in this bath for fifteen minutes, then it is well washed and brightened.

Lately a new method of applying chrome colors to wool has been developed. This is known as the chromosol method. It is claimed to give fast colors on wool just as effectively as the after-chrome method. It is a very simple process to apply and is dependable.

Chromosol is an organic salt of chromium which does not react when brought into the presence of carbonates. It is in reality the double oxalate of chromium and sodium, free from chromic acid. It possesses the property of disassociating slowly at the boiling temperature in the presence of organic substances, such as animal fibers, organic dyestuffs and the like, and it is on this property that its use in dyeing chrome dyes on woolen and silken fabrics is based.

The dye bath is composed as follows: From 10 to 15 per cent of sodium sulphate; from 2 to 4 per cent of acetic acid; variable percentage of dyestuff; variable percentage of chromosol.

The quantity of dyestuff and chromosol used in the dye bath will depend on the depth of the shade desired. This percentage will vary from 1 to 6 per cent.

The dyeing is started at a low temperature, and then the contents of the dye bath are gradually brought to a boil and maintained at the boiling temperature while the process is going on. The process is suited for dyeing all kinds of woolen materials, and the fastness of the shades is as good as any produced on mordanted wool. There are a number of precautions that must be taken in the application of this process, but these are fully described in the literature and need not be gone into at this point.

There are a great number of chrome colors. Generally the name indicates the class to which they belong. Thus, there are the acid-chrome colors, the anthra-chrome colors, chrome-fast colors, palatine-chrome dyes, eriochrome dyes, etc. The acid alizarine colors, acid anthracene, alizarine azo, anthracene acid, diamond and salicine dyestuffs are also chrome colors. Many new chrome colors have been developed in the past year or two, and just a few of the more important ones will be mentioned.

Acid Alizarine Brown CR is a chrome color, giving shades particularly fast to acids and to carbonizing. It is applied by the single-bath top-chrome method, and gives a deep reddish-brown shade on loose wool, slubbing and yarn in apparatus. Philochrome D is made in powder form, and gives a bright blue both in printing and dyeing woolen fabrics.

The first-named chrome color is used in the dyeing of blue shades on wool that must resist the action of light and fulling. The color is similar to the older members of the same series, but gives faster shades. It is dyed in an acid bath and then after-chromed. In dyeing mixed fabrics containing silk and cotton, the cotton part of the fabric is not touched by the color.

The second color is useful in dyeing wool in all conditions. It is applied by the meta-chrome method and may be used in combination with other meta-chrome dyestuffs. The shades that are produced with it are absolutely fast to light, washing and fulling.

In United States Patent No. 1,402,350 there is described a new class of dyestuffs which are made by combining the azo derivatives of such intermediate chemicals as alpha amino-2-oxynaphthyalene-4-sulphonic acid with a halogen substitution product of alpha naphthol. Dyestuffs are thus obtained which will dye wool and whose color is changed by after-chroming. By treating the dyestuffs with chromium compounds, derivatives are obtained which are also new coloring matters. These dyes are used in baths containing chrome compounds. They give a variety of shades of blue, green and violet on wool which are very fast to light and washing.

Among other new chrome colors might be mentioned Metallic Chrome Yellow GA, Chrome Fast Yellow 3RP and 5RP, Chrome Fast Orange RP, Chrome Oxan Brilliant Violet BD. The latter color is applied by the after-chrome method on woolen fabrics and may also be employed in the printing of cotton fabrics. Acid Chrome Blue BH, Chromogen Black ET, Chrome Blue R, Chrome Red B are also comparatively recent chrome colors.

Scientific Washing

Part VII—Bleach (Continued)

Commonly Used Bleaches—Javelle Water—Liquid Chlorine and Soda Ash—Chlorine and Caustic Soda —Electrolytic Bleach—Why Soda Bleach Is Best—Summary on Chlorine Bleaches—What to Use for Neutralizing Chlorine Bleaches—Non-Chlorine Bleaches—The "Reducing" Bleaches

By F. H. GUERNSEY
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Javelle Water (1)—This is the common name for a solution of sodium hypochlorite, known also as "soda bleach," "soda chemic," "electrolytic bleach," "soft bleach," etc. The important advantage in the use of this material is that there are no troublesome lime compounds present in the clear solution, and a greater softness of the bleached materials is observed.

The chemical formula for sodium hypochlorite is NaOCl, and it is always obtained in solution.

Like calcium hypochlorite, Javelle water is very unstable, being easily broken down (decomposed) by acids or heat, and also like calcium hypochlorite, sodium hypochlorite hydrolyzes to form hypochlorous acid and an alkali, the bleaching action being largely due to this reaction.

How to Make Javelle Water

The preparation of Javelle water may be done in several ways. A very common method employed in the textile and laundry industries is the decomposition of bleaching powder by soda ash. In this case all of the lime is deposited as calcium carbonate, appearing as a white residue which settles to the bottom of the container. The usual procedure is this:

(a) The bleaching powder is worked into a cream or slurry in mixing container. (Usually a 30-gallon crock.)
(b) About half of the required amount of water is added cold.
(c) The equivalent of soda ash is added, with stirring, to dissolve.
(d) The mixture is then made up to full volume and allowed to settle.

As the clear liquor only is desired, it is best to prepare the bleach in one container and, after settling, siphon off the clear liquor into a second container for use as a stock solution.

In the laundry industry, the standard bleaching solution is prepared as above from 10 pounds of bleaching powder and 10 pounds soda ash, made up to a volume of 30 gallons with water. A solution so prepared contains about 1.4 per cent available chlorine. When mixing follow the procedure given in last paragraph. In the textile industry, a lesser ratio of soda ash is frequently employed, an average being 65 pounds of soda ash to 100 pounds of bleaching powder.

In the use of sodium hypochlorite prepared from bleaching powder, care should be taken to use only the clear liquor above the sediment. The white sludge is calcium carbonate and should be carefully separated and discarded. No user of bleach can be too careful on this score. As a safeguard the jar in which the mixing is done should be elevated, and after settling the clear solution siphoned to another jar on the floor. Use the clear liquor only.

The chemical reactions involved in the preparation of Javelle water are:

Lime Bleach + Soda Ash = Soda Bleach + Salt + Calcium Carbonate, Sludge.

The solution usually contains also a small amount of caustic soda derived from reaction of the soda ash with a trace of calcium hydroxide which is always present as an impurity in bleaching powder.

In laundry practice, the modified sodas (mixtures of soda ash and sodium bicarbonate) are frequently substituted for soda ash in the preparation of soda bleach. Eighteen to twenty pounds of modified soda will replace ten pounds of soda ash. The liquor so prepared contains an excess of carbon dioxide gas (a weak acid) which consequently accelerates decomposition, and intensifies accordingly the action of the bleach. While this intensified action is measurable on a laboratory scale, in commercial operations it is hardly apparent. A liquor of this type contains no caustic soda, same being neutralized by the carbonic acid.

It seems appropriate at this point to discuss the fact that the characteristic color of a bleach liquor prepared with modified soda is pink, while that prepared from soda ash is colorless or green.

This pink color has been attributed to the presence of an iron compound (sodium ferrate) but research has quite well established that it is due to traces of permanganate derived from a slight contamination of the bleaching powder with manganese. The bicarbonate promotes decomposition of the calcium hypochlorite, with the result that the manganese is oxidized to a permanganate. The pink color may be produced in a soda ash-bleaching powder bleach by adding a small amount of bicarbonate. The color is of no significance in the use or evaluation of the bleach liquor.

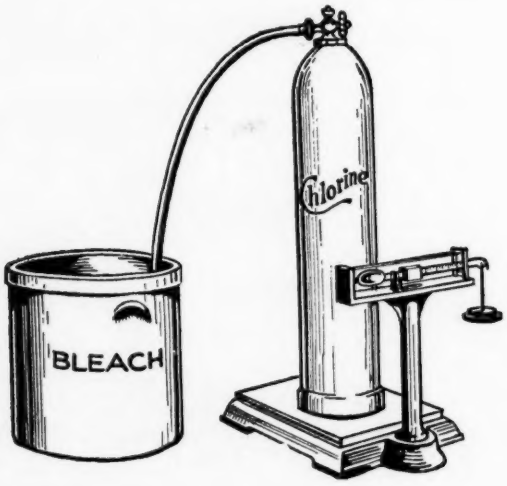
Liquid Chlorine and Soda Ash

A second method of preparing sodium hypochlorite is by saturating a solution of soda ash with chlorine gas. Liquid chlorine is obtainable on the market compressed in steel drums or cylinders holding 100 or 150 pounds. With proper methods of handling, this source of chlorine proves very convenient.

In preparing the solution 3½ pounds of soda ash will be required for each pound of chlorine. A standard 25-gallon formula would require:

5 pounds liquid chlorine,
17 pounds soda ash,
25 gallons of water.

The soda ash is dissolved in the water, and the gas conducted into the cool solution by means of a lead pipe.



During this operation, the gas cylinder rests upon suitable scales, and the loss in weight noted, corresponds to the amount of gas conducted into the soda ash solution.

A bleach so prepared contains an excess of carbon dioxide and is comparable with one prepared from bleaching powder and modified soda. The pink color is absent in this case as no bleaching powder containing traces of manganese is used.

The chemical reaction involved is:

Soda Ash + Chlorine = Soda Bleach + Salt + Carbon Dioxide Gas.

Liquid Chlorine and Caustic Soda

A third method of preparing sodium hypochlorite consists of saturating a solution of caustic with chlorine gas. One and one-quarter pounds of 76 per cent caustic will be used for each pound of chlorine gas. In the above formula, therefore, 6¼ pounds of caustic will replace the 17 pounds of soda ash.

Special precautions must be taken to prevent the caustic soda solution from heating up during the operation. If a rise in temperature is permitted we obtain a chlorate instead of a hypochlorite.

The reactions are:

Cold—Caustic + Chlorine = Soda Bleach + Salt + Water.

Warm or Hot—Caustic + Chlorine = Sodium Chlorate + Salt + Water.

The bleach liquor prepared from caustic and chlorine gas contains no carbon dioxide and is usually quite strongly alkaline.

Electrolytic Bleach from Common Salt

A fourth method which is growing in use is the electrolytic preparation of sodium hypochlorite from common salt. Passage of a direct current through a solution of salt in water results in a splitting of the salt molecule to form sodium and chlorine ions.

A simple expression of the reaction is as follows:

Salt + Electric Current = Sodium + Chlorine.

In actual practice, however, there are many side reactions which require the design of specially constructed "cells" to bring these reactions under control and assure uniform products. For instance, the sodium when released at the negative terminal at once combines with water to form caustic soda and hydrogen gas.

The chlorine then combines with the caustic soda to form sodium hypochlorite or soft bleach. The liberated hydrogen may, in turn, combine with the sodium hypochlorite to reform salt and water. The chlorine also tends to form hydrochloric acid in the neighborhood of the positive terminal, and in this acid zone sodium chlorate forms more readily than the desired hypochlorite. The specially constructed cells, however, so isolate the different products as to produce a commercially satisfactory solution containing about 0.3 per cent available chlorine, with small amounts of salt and caustic soda.

As a matter of interest, we should mention that where a supply of direct electric current is available, electrolytic production of caustic soda and chlorine gas from salt is conducted on a large commercial scale, through the use of "caustic soda" cells.

Why Electric Bleach Is Weaker Than Soda Bleach

It will be noted that the concentration (about 0.3 per cent) of sodium hypochlorite is about one-fifth that of the standard liquor prepared in power laundries by the other methods described. It follows that about five times as much is required to do the same amount of work. This limited concentration is due to a number of circumstances, but cannot be overcome, as above this concentration the hypochlorite is decomposed as fast as it is formed. Nevertheless, the solution formed is well adapted to ordinary bleaching operations, and this method is one of the most important now in use.

Owing to the fact that chlorine is very corrosive to most metals, bleaches are usually prepared in an apparatus made from wood, concrete, crockery, glass, etc.

How to Choose Bleach

A comparison of the above chlorine bleaches should be made in two ways:

First—Choose between lime bleach and soda bleach.

Second—Choose the most desirable soda bleach.

It is the opinion of authorities that soda bleach is more energetic and exerts a greater bleaching power than lime bleach. In saying this we consider the lime bleach as one prepared from bleaching powder directly, and the soda bleach as one prepared from any of the above described processes, both solutions containing the same amount of available chlorine. Different investigators state the exact ratio of bleaching ability to be from 2 to 1, to 1 to .8. It is difficult to run strictly comparable experiments with calcium hypochlorite solutions, but the consensus of opinion shows that sodium hypochlorite (soda bleach) is the better bleach.

As a rule, the soda bleach is higher in cost than the lime bleach, but this factor is usually compensated for by the greater efficiency of the soda bleach.

More Reasons Why Soda Bleach Is Best

There are several other advantages in the sodium hypochlorite solutions (especially those prepared electrolytically or from liquid chlorine) which are of utmost interest to the laundry and textile industries:

First—The greater solubility of the sodium salts.

Second—Freedom from lime deposits. In the laundry industry where the possibility of forming lime soap is a pertinent factor, the use of the straight lime or hard bleach is obviously unwise.

These advantages result in:

(a) More uniform bleaching,
(b) Greater durability of whiteness,
(c) Greater softness,
(d) Elimination of harshness,
(e) Lessened tendency toward tendering.

Summary on Chlorine Bleaches

First—In the interest of the life and quality of textiles, the calcium hypochlorite bleach (lime bleach) should not be employed in any branch of the textile industry.

Second—The various soda bleaches have been shown to be of equal or greater bleaching power when their solutions contain the same amount of available chlorine.

Third—A comparison between the various soda bleaches resolves itself into a consideration of cost and convenience, e. g.,

(a) The preparation of bleach from bleaching powder and soda is somewhat inconvenient, but lends itself to the mixing of small batches such as would be required for laundry use.

(b) Preparation of bleach from liquid chlorine is a very satisfactory and convenient method especially for the textile industry where larger quantities of bleach are required. In the laundry industry it is a matter of question whether this method is economical because of the rental charge on the chlorine cylinders. In the larger plants where a considerable volume of bleach liquor is used, this method would appear very desirable.

(c) Where a supply of direct current is obtainable at a reasonable cost, the electrolytic method will prove attractive to both large and small users. This method surpasses all others for convenience, and it is possible to produce the solution when and as required. This is of particular advantage to small users as cells of any capacity may be purchased.

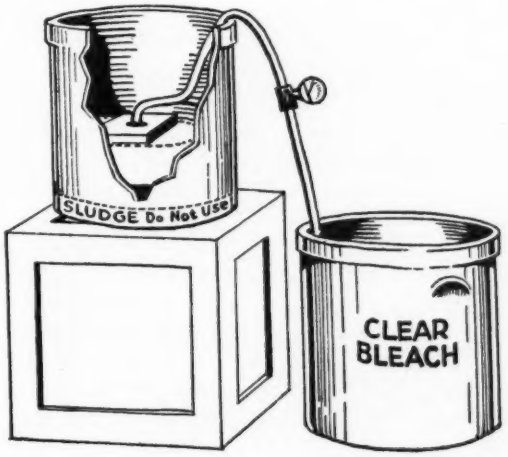
From the above, it is logical that any consumer should decide for himself in the light of his requirements and facilities, which of the described methods of producing soft bleach is best adapted to his individual conditions.

What to Use for Neutralizing Chlorine Bleach

"*Antichlors*"—In practice (especially in the textile and laundry industries) a bleach which is adapted for use in an alkaline solution is practically a necessity, although as stated above an acid bleach is more active and vigorous in its action.

The action of acids may be said to be a "two stage" action, in which the first stage results in the formation of the highly active hypochlorous acid, and also a second acid. After a short interval, these two acids begin to mutually decompose each other to form water and free chlorine gas.

Since the retention of a small amount of any of these bleaches by the fabric will result in serious tendering, the practice of employing an acid to decompose the bleach (souring) is resorted to. It is clear that any acid which



merely has alkali-neutralizing properties will accomplish the decomposition, but the gaseous chlorine which is liberated constitutes a source of danger.

It is essential therefore that an acid or other compound which is the opposite of an oxidizing compound be used to completely "kill" the oxidizing properties of the bleach. Such a compound is found in the "reducing agents" or oxygen consuming compounds. One of the most common of these found in the laundry industry is oxalic acid, which, added to an alkaline solution of bleach, will change all the chlorine to salt; and in acid solution to hydrochloric acid. Obviously all souring should be followed by one rinse at least.

We should point out that in the use of non-reducing sours, the bleaching action become more intense for a few moments, and fiber tendering may result.

Other "antichlors" are sodium bisulphite, sulphur dioxide, sodium thiosulphate (the "hypo" of photography), sodium hydrosulphite, etc. The latter, atlhough not commonly known in the laundry industry, is a very strong reducing agent.

As a general recommendation, the sour used should at least consist in part of one of the above reducing agents.

(To be continued)

DYE DIVISION OF THE AMERICAN CHEMICAL SOCIETY, WASHINGTON, APRIL, 1924

The following are abstracts of twenty important technical papers delivered before the Dye Division of the American Chemical Society at the meetings of the Division in Washington, D. C., during the week of April 21. These meetings were held in connection with the regular spring convention of the society. The abstracts should be of interest to dyers and dye chemists, as they indicate significantly the nature of the numerous research problems which are at present commanding the attention of the leading chemists in the country.

Octa-Methyl Yellow

Irving W. Fay

In the methylation of crystal violet by heating with methyl iodide in alcoholic solution, the purpose was to obtain methyl green which is heptamethyl rosaniline. Under conditions of the reaction, not a green but a yellow product was obtained. This yellow product was perhaps a further methylation product. Such it proved to be, for on staining a filter paper with it and allowing it to dry, a pale yellow spot was formed. By careful heating it turned first green, and on further heating the original color of crystal violet was restored. The final and highest methylation product, therefore, of crystal violet was octa-methyl derivative of rosaniline. This was confirmed by analysis.

Analysis of Chromotrope Acid

L. A. Pratt, A. H. Bump and C. F. Matthes

Curves have been prepared showing the effect of varying amounts of Na_2CO_3 upon the coupling of chromotrope acid and diazo-benzene. It has been found that 3½ mols. of Na_2CO_3 give the correct alkalinity for coupling 1 mol. of diazo-benzene to 1 mol. of chromotrope acid. When less Na_2CO_3 is employed, the chromotrope acid is incompletely coupled.

The Manufacture of Sodium Hydrosulphite

L. A. Pratt

Zinc dust is suspended in H_2O in a suitable container equipped for agitating and cooling. A weighed amount of SO_2 is passed into the tank at the bottom through a distributor. The ZnS_2O_4 solution thus formed is treated with Na_2CO_3 solution and the precipitated zinc carbonate separated by filtration. The filtrate containing 15 per cent $Na_2S_2O_4$ is measured and the required amount of NaCl added to salt out the hydrosulphide as $Na_2S_2O_4.2H_2O$. The hydrated salt is then converted to the anhydrous form by heating the solution and suspended solid at 60 deg. Cent. with good stirring. The crystals settle rapidly when the stirrer is stopped and the supernatant liquid is syphoned off. Three successive washes of hot alcohol are employed to further remove any water remaining with the crystals and finally to transfer the product to the dryer. The drying is carried out under a high vacuum and at a final temperature of 90 deg. Cent.

The Constitution of Columbia Yellow (Schultz No. 617)

Marston T. Bogert and Frank H. Bergeim

Although generally assumed that Columbia Yellow is a true azo dye, experimental proof of the fact has been lacking and other formulas have been proposed. In the latest edition of Schultz Tables (Sixth Edition, No. 617) no constitutional formula whatever is given for it. Investigation of the chemical behavior of the dye, and its synthesis by other methods than that involving the action of hypochlorites upon the sodium sulphonate of dehydrothio-p-toluidine, have now shown conclusively that the azo formulation is the correct one.

The Constitution of the So-Called "Pechmann Dyes" and the Mechanism of Their Formation from Beta-Benzoylacrylic Acids

Marston T. Bogert and John J. Ritter

These dyes are shown to be the dilactones of diphenacylfumaric acids. The mechanism of the reaction involves a preliminary dehydration of the benzoylacrylic acid to an unstable allene lactone, which immediately undergoes a bimolecular rearrangement and condensation to the dye.

(Continued on page 307)

Proceedings of the American Association of Textile Chemists and Colorists

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APRIL MEETING, NEW YORK SECTION

The April meeting of the New York Section, American Association of Textile Chemists and Colorists, convened in Stewart's Restaurant, 30 Park Place, at 8.25 P.M. on April 25th, Herbert Grandage, Secretary of the Section, presiding in the absence of Chairman Killheffer.

. . . Mr. Grandage read the minutes of the last meeting. . . .

Chairman Grandage—The Treasurer has a report which we will have at this time.

Mr. Wilmuth—All bills are paid and we have a balance of $56.04.

Chairman Grandage—I believe that the Nominating Committee is not quite ready to report to us to-night and, Chairman Killheffer not being here, we had better table that until next month and have the Nominating Committee present their report the same night the election is held.

. . . Mr. Howes then made an announcement concerning the dinner to Hon. Francis P. Garvan on April 26th. . . .

Chairman Grandage—If there are no other matters of business that should be brought forth at this time I think we will go directly ahead with the paper that is to be presented this evening.

We have with us to-night Dr. Wuth, of the Ciba Company, who has kindly consented to present a paper the title of which is, "The Influence of Dispersion on Vat Dyeing." I am sure we will all be interested in what he has to present for us. Dr. Wuth! (Applause.)

THE INFLUENCE OF DISPERSION ON VAT DYEING

By B. WUTH, M. A., Ph. D., L. L. D.

[EDITOR'S NOTE.—In the course of his paper the speaker exhibited a number of solutions of dyestuffs and other substances which had been filtered and passed through a dialyzer illustrating the difference between molecular-disperse and colloid solutions, at the same time showing that dyestuffs of lower molecular weight—such as Chrysoidine, Safranine, Methylene Blue and Malachite Green—diffuse and dialyze, whereas dyestuffs with higher molecular weight—such as Congo Red, Alkali Blue, Night Blue and vat colors—show a distinct colloid nature inasmuch as they pass through an ordinary filter but do not diffuse or dialyze.]

Gentlemen: It is not my object this evening to advance any scientific explanation of what takes place in the dye vat or during oxidation and development beyond the knowledge of elementary chemistry, but I wish to suggest looking to colloid chemistry for explanations of the amazing number of occurrences in vat dyeing, as chemical and physical theories have so grossly disappointed us.

The colloidal theory of dyeing is not novel, but it pertains to the production of substantive and adjective dyeings. It having been ascertained that many dyestuffs possess colloidal character and that the colloidal state of a body can cause a change in its behavior in various directions, it would seem promising to look to the young science of colloid chemistry to cast some light on the phenomena of vat dyeing.

Colloid chemistry has shown that no sharp dividing lines can be drawn between suspension and solution, and has substituted for these two categories the theory of dispersion.

I desire to say a few explanatory words on the fundamental phenomena and principles of colloid chemistry, especially to the younger members of the Association, whose time has not permitted them to enter into this world of strange apparitions and thought in order that they possibly may gain a new viewpoint in their daily contact with chemical things and assist in the unveiling of the mysteries of the vats.

A colloid is not a chemical complication, as is frequently said; we know quite a number of elements and simple chemical compounds in colloid state; there exists no simple relation between chemical constitution and colloid state.

The general chemical-physical qualities of a substance do not theoretically denote if it is a colloid or not; we have to fall back onto the experimental distinctions of colloid substances in general. A number of simple qualitative tests help us to decide whether we have a colloid under examination or not; in other words, we must make a short qualitative colloid-chemical analysis.

For such analyses we avail ourselves of the experiments on diffusion, the fundamental principle of which is generally known. The observance of diffusion was followed by the recognition of dialysis—the diffusion of dissolved substance through a membrane. Substances which travel in free diffusion diffuse also through membranes and, on the other hand, non-diffusible solutions do not pass through the dialyzer.

We have here two characteristics of colloid solutions; they do not diffuse and do not dialyze. These alone, however, are not sufficient, for fine deposits or precipitates of insoluble matter, mechanical suspensions or emulsions do likewise neither diffuse nor dialyze.

Colloid solutions possess the property of molecular solutions to pass through every kind of filter paper; but, on the other hand, some quite insoluble precipitates also pass through filter paper, as is known to every analyst; so the assumption lies near that colloids are but fine precipitates.

Typical colloids do not show any particles under the microscope, whereas typical suspensions show individual particles quite distinctly. The practical boundary between colloids and suspensions is given by the efficiency of the microscope. It follows from the theory of the microscopical resolving power that we can never perceive particles which are smaller than one-half of the wave length of light. If we revert to microphotographical methods in short-rayed ultra-violet light, the extreme efficiency of microscopic resolving power gives a value of approximately 0.1 μ. This value is arbitrarily used as a boundary point between coarse dispersions and colloid solutions.

Other methods of research give similar values. The diameter of the pores of the finest filter is about 1 μ, almost the same value as that of the microscopic power. It is therefore regarded as characteristic that typical colloid solutions pass through filters of the mentioned fineness, whereas coarse dispersions are separated on filtering.

In seeking the other boundary point between colloid and molecular disperse solutions we primarily establish that according to the calculations of physicists and chemists the value of the dimensions of typical molecules lies between one ten millionth and one millionth part of a millimeter (—0.1 to 1 μμ).

The dispersive region of colloids lies, according to these determinations, between the boundary points of one ten thousandth and one millionth of a millimeter, and we thereby gain a theoretical definition of the colloids. In an experimental respect, colloids differ from coarse dispersions—i. e., from suspensions in the ordinary sense of the word—inasmuch as, contrary to the latter, they are not microscopically decomposable, and they pass through ordinary filters, which the latter do not. On the other hand, colloids differ from molecular-disperse systems, inasmuch as the latter diffuse and dialyze, whereas colloids do not.

Between the two boundary lines against coarse dispersions and molecular-dispersoids lie the colloids, with rising or falling degree of dispersion.

Leaving aside the internal changes of state—i. e., the variations of the colloid state which express themselves in viscosity—we shall examine more closely the coagulation and the peptization, as these changes of dispersity will occupy us a little later.

The theories of the processes of coagulation are electrical, chemical and mechanical, of which, for our purpose, we may exclude the mechanical, the dispersive reduction by vigorous centrifuging.

The electrical and chemical coagulations are juxtapositional. The dehydrating actions of neutral salts, however, are certainly not of electrical nature, although without doubt they can be influenced also by the electrical charge. Electrical and non-electrical processes take place in the precipitation of hydrated emulsoids with neutral salt, which is perhaps best concluded from the fact that the whole salt—i. e., both ions—participates in the precipitation.

When suspensoids and hydrated emulsoids are mixed together, the interesting fact results that the greater stability of the emulsoid part is, so to say, conveyed onto the suspensoid and this is rendered

much less sensitive to the addition of salt. This phenomenon is termed the protective effect of emulsoid colloids, and is explained by the assumption that the fluid emulsoid drop envelops the suspensoid particles or combines in some similar manner.

The last group of changes of colloidal state that is of interest to us to-day is the adsorption, the changes in concentration which colloid and, generally speaking, all disperse systems undergo at the surface of contact with other spheres. This change of concentration results simply in a difference in concentration between surface of contact and the main body of the disperse system. Later, after this difference of concentration has been established, a number of secondary processes can take place. In the most frequently occurring positive sorption a fixation of the colloid or of the entire disperse body can take place on solid, liquid or gaseous sorbents and can be carried that far that the remaining portion of the disperse system can be poured off without disturbing the dispersoid on the contact surface. This can be done by coagulating the colloid to a cohering stratum. Finally, chemical reactions can take place in the surface, such as polymerizations, hydrolysis, oxidation, etc.

Of the number of adsorptions we may mention, as example, the rapid and total sorption of colored suspenoids by carbon. This sorption is important and decisive for the union of colloid dyestuff with the fiber, of which mention will be made later.

These few principles and peculiarities of colloid chemistry may for the present suffice to investigate if vat dyeing is really a colloidal process, and if we can influence the working state of a vat in any way by employing the various methods of coagulation and peptization, in order that the dyer may in all cases obtain the same good results without having to rely too much on the special mechanical design of his dyeing equipment; that means to say, if we cannot reach conditions conformable to rule under which good dyeings can be produced under less complicated mechanical conditions.

The old chemical theory of dyeing that found a number of points of support in wool dyeing did not satisfy, as it did not prove the existence of a chemical combination with dyestuff and fiber, especially cotton. The mechanical theory only proved seemingly correct in a few instances. The theory of the solid solution does likewise not explain all occurrences in dyeing, and one must deplore that these theories were put in opposition to each other for, co-ordinated and perhaps with the assistance of electrical influence in the dye bath, a much greater field might have been covered.

Colloid chemists naturally turned their attention to the technical and practical application of their theories, and although they found later that many dyestuffs are colloids they based their theory of dyeing on the fact that the textile fibers are invariably of colloid nature and conjectured a diffusion or dialysis of the molecular-disperse dyestuff solution in and through the cellular tissue and the cell walls which would act as the membrane of a dialyzer.

As an example of such purely colloid process let us take the dyeing of wool with a dyestuff—e. g., Acid Scarlet. The dyestuff solution is molecular-disperse; it diffuses and dialyzes, and dialyzes, therefore, into the interior of the fiber. In this colloidal process only the fiber possesses colloidal nature.

As soon as it was established that the majority of dyestuffs, especially those with high molecular weight, are colloids and give the same results in dyeing, the contradiction was apparent, as these dyestuffs, on account of their colloidal nature, cannot diffuse or dialyze through the fiber membrane.

If we presume a colloid dyeing with vat colors in the sense of the colloidal nature of the dyestuff, we must ascertain if the leuco solutions are molecular-disperse or colloid.

According to their molecular weight they would be assumed to be colloids, as the degree of dispersion sinks with the increase in molecular weight.

The qualitative colloid-chemical analysis shows us that the aqueous solutions of the sodium or potassium salts of the leuco compounds of vat dyestuffs pass through an ordinary filter, but do not diffuse or dialyze.

For these tests we used ordinary tubes of very fine filter paper as they are used for biological purposes. Without treatment they can be used for diffusion tests, whereas for dialysis they are coated with collodion and serve as membrane.

Our aqueous solutions of the salts of the leuco vat dyestuffs are colloids, but we cannot determine their degree of dispersion without complicated and elaborate research. Theoretical considerations must lead us to choose fine disperse or coarse disperse states of solutions for the various phases of dyeing.

We have to discriminate between two main stages —that of dyeing and that of fixation.

According to the quantitative rules of adsorption that relatively much is absorbed from dilute solutions, we shall use longer or more diluted dye liquors. In this dilute solution the dispersoid should in its dispersion be brought as close as possible to molecular-dispersion, and we must therefore peptize the solution to the limit. Such solution will penetrate and cover the fiber better and more evenly than a coarsely disperse solution would. As soon as a maximum of sorp-

tion seems to be reached beyond which no further concentration takes place on the surface of the sorbent, a coagulation of the dyestuff on the fiber must take place on the one hand to prevent a wandering of absorbed particles, and on the other hand to displace the equilibrium between solution and sorbent in order to make a further adsorption of dispersoid from the bath possible. The method of coagulation must necessarily be such that no chemical reaction can take place which could cause constitutional changes in the dye bath. Likewise, the method of peptization must be chemically indifferent or at least not be contrary to sought reactions.

The dye bath is prepared with the insoluble dyestuff, the reducing agent, hydrosulphite, to convert the dyestuff into its leuco state, and alkali to convert the leuco compound to its soluble sodium salt. An excess of reducing agent is necessary to counteract oxidation caused by atmospheric oxygen during the dyeing process. An excess of alkali serves to neutralize the bisulphite formed in the decomposition of the hydrosulphite, and accordingly to prevent the abstraction of sodium from the leuco salts, which would result in precipitation.

Hydrosulphite and its decomposition products act like almost all acids and neutral salts coagulating on colloids; the excess of hydrosulphite must therefore not exceed the chemical requirements. Alkali, however, acts peptizing and the dye bath stands and demands a large excess over the amount necessary for the regulation of the chemical work in the vat. In dyeing processes where peptization is essential, too little alkali causes uneven and loose dyeings.

The degree of alkalinity for practical use is limited to the possibility of handling the goods, and therefore also the degree of dispersion of the vat liquor; but here we find valuable assistance in the effect of the protective colloids.

It has been mentioned that hydrated emulsoids protect the enveloped suspensoids from coagulation—i. e., maintain the original degree of dispersion. This is a means of having the highest degree of dispersion in the dye bath without increasing the alkalinity of the liquor beyond reasonable and practical limits. In the preparation of the stock vat an excess of alkali is used, but the dye vat is furnished with a protective colloid. By the dilution of the stock vat to a dye vat the degree of dispersion of the colloid dyestuff is not reduced and the alkalinity can almost be reduced to a minimum without altering the dyeing properties of the vat.

The various emulsoids have a varying effect, but not so pronounced in their protective qualities for the retention of dispersion as in their reversibility.

When the dyestuff is on the fiber it should coagulate, but it does not coagulate when it is embedded in a reversible protective colloid and reproduction or the maintenance of the former conditions suffices to reform or prevent a coagulation. For this reason preferably, irreversible protective colloids are employed which, when once coagulated on the fiber, do not detach themselves and likewise prevent the detaching of the protected suspensoids. It is wrong to regard the irreversibility of the precipitation as characteristic of the coagulation suspensoid colloids, and it is therefore necessary to consider the reversibility when choosing the protective colloid. Whereas the oil and soap emulsoids almost without exception coagulate reversibly, there are still a large number of other colloids with opposite properties which seem to be more advantageous for vat dyeing and have already given good results. To mention one of these, I remind you of the effect of the effluents of the manufacture of sulphite cellulose, which allow a reduction of the alkalinity of the dye bath to one-eighth or one-tenth of the original requirement, an important feature in the dyeing of animal fiber or of highly acetylated cellulose.

The object of the vat dyer is to produce an irreversible coagulation before changing the soluble leuco compound back to its insoluble state and there are several methods at his disposal. The simplest are the influence of acids, salts or heat, whereby the dyestuff suspensoids coagulate, like albumen. It is apparent that in using acid a purely chemical reaction can take place beside the coagulation; namely, the extraction of metal and the precipitation of the insoluble leuco base. Salt also "salts out," but the coagulating effect can be considered an established fact. The raising of the temperature of the dye bath toward the end of the dyeing operation, even to boiling point, tends to the same and has in many cases quite surprising effects.

So far we have discussed the processes during the dyeing operation and the necessary procedure for the desired structural changes. It remains to see what causes the marked adherence of the dyestuff to the fiber, which in most cases is that firm that the combination cannot be loosened by ordinary agents.

Neither the chemical nor the mechanical theories of dyeing explained the fastness properties of dyeing, and we prefer the colloidal theory, as we are working with typical colloids. But the theory that a dyeing is produced by osmotic pressure does not furnish an explanation when both fiber and dyestuff are colloidal. We turn our attention to the earlier mentioned facts of adsorption, which are caused by change of concentration by some potential of energy neighboring on a contact surface. As in the case with the production and the destruction of colloid state, various principles

can be responsible for the local change of concentration, and the theory of Willard Gibbs, modified by Ostwald, may be accepted—viz., Is there any potential of energy in a surface of contact which can be reduced when a change in the concentration of a neighboring dispersoid, sorption, takes place? Has the sorbent an electrical potential difference and the disperse phase an opposite charge the potential difference will be neutralized, and we speak of electrical sorption. A mechanical absorption may be due to ordinary surface tension. If there is a chemical potential difference between the sorbent and a dispersoid, a chemical reaction will take place at the surface of contact.

There would seem to be a certain chemical relationship between vat dyestuffs and the fibers, and this relationship can be more or less pronounced; in all cases of adsorption we may assume a transition or a relation between these colloid chemical and purely chemical reactions.

It remains to gather from practical work more confirmation of the colloid theory, which certainly will forthcome by close attention. If the theory be correct or not, nothing will be lost by a close investigation of the influence of dispersion on vat dyeing. (Applause.)

Chairman Grandage—I am quite sure that if Dr. Wuth's theory that he has expounded to us to-night on the dyeing of vat colors is right there is an answer to the troubles that we all have with them.

Dr. Wuth said that he would be perfectly willing to answer any questions that anybody wants to ask him. He has corrected me. He says he will try to.

Mr. Davis—Will Dr. Wuth please explain why in the anthraquinone series and the indigoid series caustic soda is used considerably less in the indigoid than in the anthraquinone series, particularly in Helindone and Ciba colors?

Dr. Wuth—Mr. Davis, all literature that I have seen and all recipes published by dyestuff makers of the various brands always put a minimum of alkali into the indigoid and thio-indigoid baths and stipulate a larger minimum of alkali for the dye bath of the anthraquinone series.

I believe that the recipe for the anthraquinone series is the nearest to the correct amount, while the amount given for the Ciba, Helindones, Thio-indigos, etc., is insufficient. It may be sufficient for any laboratory dyeing where you carefully put a piece of cloth or whatever it is into the bath and do hardly stir it, but the practical dyer, however he may be afraid of stirring his vat, can't alter the working of his machine; he introduces oxygen and he has to have the larger amount of alkali, otherwise he has continually to watch the bath carefully with hydrosulphite and caustic soda within ready reach.

Mr. Davis—I have made some tests and find that with the same amount of caustic as called for by anthraquinone colors the indigoids will go to pieces. When the temperature is reduced between 120 deg. to 140 deg. Fahr. the caustic soda seems to break up the dyestuff.

Dr. Wuth—That is an observation I have never made. I have frequently made the observation that the dyestuff has broken up and possibly one might put it down to the springing of the vat, but I believe it was probably an error in observance of the temperature or a shortness of hydrosulphite.

I have dyed indigoid colors and have gone to an excess of alkali far beyond what the recipes ever called for, and I have never known any deterioration or precipitation in the vat due to an excess of alkali. It would be very interesting if you could let us know what colors you were experimenting on.

Mr. Davis—One of the indigoid groups.

Dr. Wuth—The indigoid dyestuffs are by their nature closely related to Indigo itself.

I might have mentioned this evening that Indigo itself can stand a large amount of alkali and carry out the colloidal theory; every Indigo dyer knows that he can get a better and faster dyeing by giving more dips in a weak and strongly sprung vat than he can by giving few dips in a concentrated and weakly alkaline vat.

That would speak for the fact that alkali does not destroy the dyestuff, and on the other side for the theory that from a dilute solution the fiber will take up more, because it does not get so quickly into an equilibrium on the surface of contact.

Mr. Davis—I have found glue to be beneficial.

Dr. Wuth—Glue is certainly a colloid like all others, and it would greatly depend upon what glue you have used, whether it is reversible or irreversible. Most of the fish glues are irreversible, but you can even find, I suppose, adulterated fish glues which are not irreversible. Whether the ordinary carpenter's glue is reversible or not I don't remember.

Mr. Keeler—I would like to ask Dr. Wuth how he would aid penetration of mercerized goods?

Dr. Wuth—I think that is another question that comes into our subject this evening. In very thin materials such as voiles, mercerized, the mercerization takes place more on the cell itself, on the thread itself and leaves interstices to let the dyestuffs go through, and you get quite a good penetration there.

Mr. Keeler—I was speaking of skein yarn.

Dr. Wuth—I should think it is due to the physical change in the cellulose by mercerization. We know that caustic soda causes a physical change, and it would seem that, especially in a dry mercerization, the whole fiber was coated with a membrane. We will say that the gelatinous state of the fiber caused by mercerization causes

neighboring cells to stick together and form a stratum. That means that the whole fiber—or in piece goods, the whole piece—would be protected by a membrane.

This membrane naturally would not allow the vat dyestuff to dialyze through it. So that in a non-mercerized piece you would be able to get better penetration than in a mercerized piece.

To get perfect penetration it would, therefore, seem advisable to dye first and mercerize later.

Mr. Keeler—Is there any addition that you can make to drive it in? Could you use an excess of heat?

Dr. Wuth—I don't think that any addition to the dye vat could cause the dyestuff to penetrate such a cellulose membrane as would be formed by mercerization because we have no means so far available which will, let us say, peptize the colloidal state of the leuco dye solution into a molecular disperse state. As soon as we could do that, it would penetrate through the membrane.

Mr. Davis—I would like to ask another question.

In the course of your paper you said something about the excess of hydrosulphite that is necessary. Do you know of any qualitative tests by which you can determine the excess of hydrosulphite in an alkali vat?

Dr. Wuth—No. There are two tests that we have been looking for for years; that is, a quick test to determine with some accuracy the amount of free hydrosulphite you still have in the bath, and a test as to the alkalinity. There are some very simple methods, but the color of the dye vat makes it difficult to use indicators. It is a problem that has been studied, I think, for the last twenty years and I have not heard of any solution yet.

Mr. Davis—Alkalinity you take, then, on turmeric-paper?

Dr. Wuth—It is a very uncertain indicator.

Mr. Davis—I have tried one method: I have taken Indanthrene Yellow, the brand they use for staining paper, which is almost soluble in water, and soaked strips of filter paper in it, and in that way gotten an enormous excess of hydrosulphite that would go violet blue. If that was a red vat, you would see that red with the blue edge of the Indanthrene Yellow.

Dr. Wuth—That is certainly very interesting.

Chairman Grandage—If there are no further questions, I think probably a motion to adjourn is in order. However, just before closing I want to discuss for a moment the question Mr. Keeler brought up about whether penetration of vat colors in mercerized goods can be helped.

Some few months ago at one of our meetings I presented a very short paper and said as little as I could say and get away with it. I mentioned pyridine and glue. I don't know whether it is mechanical, or colloidal, or whether some of these other reasons that Dr. Wuth has given us to-night are involved, but certainly in laboratory trials some of the vat colors (and particularly with twisted, mercerized yarns) do get considerable assistance from a penetration standpoint by the addition of pyridine and glue.

I have had a great many arguments with men who have conducted this same laboratory trial that I conducted, to see whether these two particular things really helped in the results obtained, or whether it was mechanical in the handling of the yarn itself; but there is every indication that it helps penetration in hard, twisted, mercerized skein yarns with vat colors.

In addition to that, there are one or two other phases of the handling of skein mercerized yarns with vat colors that do help penetration, that are purely mechanical; that is, the splitting of the dye bath. That is, not entering yarn into a dye bath with a complete amount of dyestuff to get the full shade, but splitting it into several portions and manipulating between the additions. I think that is purely mechanical, and nothing else, just a means of forcing in between the actual staple of the cotton. I doubt very much if it has anything to do with the actual penetration of the staple itself.

Is there anyone else who wants to ask any questions of Dr. Wuth?

Mr. Rudolph—Could the fastness to crocking of vat colors be connected in any way with this theory of dispersion? I have a special color in mind; that is, Ciba Scarlet G, or Thio-Indigo Scarlet 2G.

Dr. Wuth—Referring to Mr. Grandage's remarks I might say that they are very interesting. Shall I understand, Mr. Grandage, you used pyridine together with glue in the dye bath?

Chairman Grandage—Separately.

Dr. Wuth—Many vat dyestuffs in reduced and unreduced state are soluble in pyridine, as in many other organic solvents.

If the individual color that you are using is soluble in pyridine, then the solution is not a colloidal solution; it must be molecular disperse. That will go through the supposed membrane on the fiber produced through mercerization.

Possibly glue does the same—glue, as Mr. Davis has already mentioned, as a protective colloid—has certainly the action of upholding the dispersion of your original solution, so that you would be about as near to the boundary line between the colloidal state and the molecular solution as you could possibly get.

Theoretically, that solution would not diffuse or dialyze through this membrane. If, however, you handle the cotton, as you say, mechanically, you will break up that membrane surface on it, the same as you would in a wax surface in the batik dyeing. The dyestuff could enter in the crevices between the breaking of that mem-

brane, and then naturally it would have free run in the inner cells of the vat.

On the question as to crocking, it is certainly true, and I don't think there has been a method found to quite overcome the crocking of thionaphthene dyestuffs. You know the Thio-Indigo Scarlet stands alone in a chemical class, except for the brominated products of it. It certainly has quite a number of properties which do not fall in line with other thio-indigoid or anthraquinone dyestuffs.

In making up solutions, we notice its behavior in the bath; it requires a very low temperature. At higher temperature it has a tendency to turn into a hazy substance. In calico printing we find that under certain circumstances it may cause a little difficulty. It sublimes more than any other. It seems in that respect to be very close to the mother substance, Indigo. In fact, we might call it the missing link between Indigo and Indigo derivatives, but still it is a color which has secrets that we have not fathomed yet.

A rising vote of thanks was extended the speaker of the evening for his most instructive paper. A vote of those present showed a majority in favor of holding the next and final meeting of the season in Newark, N. J., whereupon the meeting adjourned.

TWENTY-SECOND COUNCIL MEETING

The Twenty-second council meeting of the American Association of Textile Chemists and Colorists was held at the Engineer's Club, Boston, Mass., on Friday afternoon, March 28, 1924.

The following members were in attendance: L. A. Olney, Wm. D. Livermore, Wm. H. Cady, W. C. Durfee, A. E. Hirst, Geo. A Moran, W. M. Scott, Wm. R. Moorhouse, H. Christison, Wm. K. Robbins, W. E. Hadley.

[The names of those elected to active and junior membership at this meeting were published in the April 21 issue of the Proceedings.]

The matter of the next annual meeting was taken up, and the secretary was instructed to write Dr. Hollander, chairman of the Philadelphia Section, relative to the steps which should be taken in preparation for this gathering.

The motion was made and carried that the President appoint a committee of three or more members of the Council, to review the applications for membership in order that so much time need not be consumed by the entire Council in such matters. This committee will choose those applicants which are unreservedly qualified for membership, and make such recommendation to the Council; at the same time presenting the names of those applicants whose qualifications require more mature deliberation.

Some question arose in the Council as to the necessity of more careful consideration of some of the applicants for membership. It was considered desirable that all members who act as sponsors for applicants should consider it very seriously, as the Council is in many instances absolutely dependent upon the opinion and the reliability of the member who is acting as sponsor, in order that a fair appraisal of the eligibility of applicant may be made.

The secretary was authorized to send out a questionnaire in order to obtain accurate data for the publication of the 1924 Year Book. It was further considered desirable to have a copy of the questionnaire printed in the Proceedings of the Association in order that every member would be sure to see same, in case his address might be wrong in the records.

Respectfully submitted,

W. E. HADLEY, Secretary.

TWENTIETH RESEARCH COMMITTEE MEETING

The twentieth Research Committee meeting of the American Association of Textile Chemists and Colorists was held Friday afternoon, March 28, 1924, at the Engineers' Club, Boston, Mass.

The following members were in attendance: L. A. Olney, William D. Livermore, William H. Cady, W. C. Durfee, A. E. Hirst, George A. Moran, W. M. Scott, William R. Moorhouse, H. Christison, William K. Robbins, William D. Appel and W. E. Hadley.

As a result of several suggestions which have been made relative to the preliminary fastness tests published in the 1923 Year Book, there will shortly be published supplementary data covering certain sections of the work.

The committees working on the Fastness to Perspiration as well as the Fastness to Light reported progress.

Respectfully submitted,

W. E. HADLEY, Secretary.

STANDARDS FOR THE TESTING OF DYES AND DYED FABRICS

Textile Chemists and Dye Manufacturers Confer with Officials of the Bureau of Standards

A conference was held at the Bureau of Standards in Washington on April 23, 1924, in which representatives of the Bureau of Standards conferred with representatives of the American Chemical Society, American Association of Textile Chemists and Colorists, the Synthetic Organic Chemical Manufacturers' Association, National Association of Wool Manufacturers, the National Association of Hosiery and Underwear Manufacturers and the American Cotton Manufacturers' Association.

Dr. G. K. Burgess, Director of the Bureau of Standards, presided and outlined in considerable detail the work which has already been done toward overcoming various problems which confront the dye industry. He called attention to the fact that already work had been done toward the adoption of methods for measuring the strength and fastness of dyes. While the problem of standardization of dyes has been considered by textile chemists for some years, it is only lately that the Bureau has been able to fully co-operate with the trade or to adopt a definite program which would tend to solve the many dye problems with which the industry is confronted.

Dr. W. D. Appel, of the Bureau, explained in detail a method which he is at present working on, whereby uniform dyeings can be made in a very short time. This process eliminates many of the variations which are always present in mill laboratory work.

H. F. Wilmot, of the Synthetic Organic Chemical Manufacturers' Association, stated that this organization was prepared to co-operate with the Bureau and could furnish samples of different American-made dyes. Mr. Wilmot further stated that it would be possible for them to establish a fellowship at the Bureau to carry on a definite line of work.

Prof. Louis A. Olney, of the Lowell Textile School, spoke of the necessity of funds for carrying on research work, and stated that while the American Association of Textile Chemists and Colorists would be glad to co-operate with the Bureau in the different phases of work, he felt that the matter of funds should be brought to the attention of textile manufacturers, who ought to be willing to bear a major portion of the expense. Professor Olney pointed out that textile products to the value of $5,000,000,000 were produced during 1923, and that one-hundredth of 1 per cent of that amount put aside for research work would place the textile industry in a position far ahead of other industries, so far as co-operative research work was concerned.

Dr. Burgess felt that standards could be established that would allow the consumer to have definite data relative to the fastness of the different dyestuffs which he might be using.

Dr. Hale, of the Dow Chemical Company, stated that dyes of American manufacture should be designated by name and number, and verified by the Bureau of Standards, and that American manufacturers should conform to such standards.

It was finally decided that a committee should be appointed from the four associations represented and that a general program should be drawn up which could be submitted to the different organizations for criticism.

It was felt that the following would serve as a basis for research work for dye standardization: (1) Nomenclature; (2) method of testing strength of dyes; (3) method of testing fastness of dyed fabric to light, etc.; (4) application of dye to fabric.

The following were represented at the conference, which was presided over by Dr. C. K. Burgess, Director of the Bureau of Standards: Members of the American Association of Textile Chemists and Colorists present were: Louis A. Olney, Lowell Textile School; W. E. Hadley, Clark Thread Company; Hugh Christison, Arlington Mills; George A. Moran, Pacific Mills; D. S. Ashbrook, Joseph Bancroft & Sons Company; Dr. Walter M. Scott, Cheney Bros., and W. C. Durfee; W. F. Edwards, U. S. Testing Company; P. H. Bates, Bureau of Standards; C. C. Hubbard, National Association of Cleaners and Dyers; E. M. Schenke, National Association of Hosiery and Underwear Manufacturers; W. D. Appel, Bureau of Standards; C. W. Schoffstall, Bureau of Standards; Walter Humphreys, National Association of Wool Manufacturers; A. S. Cramer, American Cotton Manufacturers' Association; Harrison F. Wilmot, Synthetic Organic Chemical Manufacturers' Association; F. B. Gorin, chemical director, Department of Commerce; K. S. Gibson, Bureau of Standards; F. R. McGowan, of the Bureau of Standards; William J. Hale, Dow Chemical Company, and R. Norris Shreve, American Chemical Society.

APPLICANTS FOR MEMBERSHIP

Active Membership

Campbell, George A., assistant chemist, Dyestuffs Corporation of America, Boston, Mass. Sponsors: B. C. Bond and J. F. Bannon.

Dabbs, Ben R., dyestuff salesman, Charlotte, N. C. Sponsors: E. H. Hinckley and P. F. O'Neill.

Koehler, Albert E., dyer, Kaufman Plush Company, Philadelphia, Pa. Sponsors: B. Kendal Archer and E. C. Bertolet.

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Smith, Walter C., textile chemist, American Aniline Products, Inc., New York, N. Y. Sponsors: Wm. D. Baird and A. F. Musgrave.

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Junior Membership

Taylor, Oscar C., second hand, dyehouse, Farwell Bleachery, Lawrence, Mass. Sponsors: A. K. Johnson and H. Grimes.

AMERICAN
DYESTUFF REPORTER

Devoted to the use and application of dyestuffs and the mechanical equipment incidental thereto.

LOUIS A. OLNEY
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Directing Editor

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THE DYESTUFF EXPORT MARKET

THE trade press has recently given considerable attention to the possibility of developing the export market for American-made dyestuffs. For the most part the articles on this subject have been of an optimistic nature, the substance of which would appear to be that in the development of foreign fields lies the salvation of the American dyestuff manufacturing industry. One article, sponsored by a Government official who has had wide experience in dyestuff matters, uses the phrase "will to export" as the chief element needed to insure success in this direction.

We assume that the "will to export" covers a multitude of activities. It would mean not alone the determination to succeed but a careful study of foreign markets, compliance with customary modes of merchandising in various countries, research into local trade requirements and a comprehensive technical service extended to the customers served.

Assuming, however, that these prerequisites to satisfactory trade relationships are complied with on the part of domestic manufacturers, there still remains the all-important element of price. After all is said and done, no consumer of dyestuffs, whether here or abroad, can be expected to patronize a source of supply which is unable, for whatever reasons, to meet the prices of its competitors. Admitting, for the sake of argument, that we can meet our chief competitors, the Germans, in all points of service, standardization, etc. —a task extremely difficult but perhaps possible of accomplishment—the question then is: Can we meet their prices?

During 1923 our dyestuff and other coal-tar chemical export business experienced a very marked revival. This revival was due, however, almost in its entirety to the fact that the German plants in the Ruhr were so hampered by the French occupation as to be able to produce little or nothing for the export market. This condition naturally compelled consumers in non-producing countries to look elsewhere for their source of supply and afforded American manufacturers an excellent opportunity to obtain business with comparatively little competition.

To-day, however, the situation is vastly different. The German plants, with one or two exceptions, are producing at record capacity, and advices from all parts of the world indicate a renewed determination on the part of German agents to secure dyestuff business on any terms possible.

During the last few years the German costs of manufacture have been tremendously affected by the progressive fall of the mark. The Germans have, in effect, been able to manufacture on a currency basis which was constantly approaching the vanishing point and meanwhile to sell on a gold basis which remained practically stationary. Through the same agency German dyestuff manufacturing plants have been able to eliminate their capital investment. Bonds and other security issues, placed with the public when the mark was at parity, have been redeemed with practically worthless paper. The result is that these plants have no fixed capital charges and hence enjoy a greatly decreased overhead as compared with the rest of the world.

Moreover, labor costs in Germany, even on a gold basis, are vastly lower than in America. The American standard of living and the consequent wage scale in effect here places our manufacturers in every industry at a marked disadvantage when brought into competition with foreign-made merchandise. Conditions existing in the fine cotton goods market at the present time emphasize this point of labor costs. English manufacturers are to-day importing and selling in this market a great quantity of fine cotton goods, the raw material for which is grown in this country, transported to England, there woven and processed, and eventually returned to this country at a cost materially lower than similar goods can be domestically produced.

In the case of dyestuffs the situation is materially more aggravated, for here Germany has the advantage of many years of experience and a consequent elimination of research costs as opposed to the American manufacturer.

The most encouraging point in the dyestuff export situation is the fact that American manufacturers have apparently been able to compete successfully on one tonnage product; namely, Indigo. It is a fact that China, which is the largest individual consumer of Indigo, is to-day buying a large portion of her supplies from American sources and that the current market price for this product in China is somewhat higher than it is in this country. This would seem to indicate that in the case of certain colors of which there is great quantity consumption it may be possible for American manufacturers to compete successfully in foreign markets. The answer here, no doubt, is that American mechanical genius has devised means of

handling the processes of manufacture which eliminate a great deal of the human labor element, and hence this large item of cost, ordinarily so disadvantageous to this country, is obviated.

Surveying the world as a whole, it would appear that the Orient, and particularly China, offers the best potential export market for American colors. Here geographical location favors us to some extent, and in the case of China the well-known friendship of its people for the American nation has a certain beneficial influence. The Mexican and South American markets, which might ordinarily be supposed to offer similar advantages, are, unfortunately, so thoroughly dominated by the practice of commercial bribery that it is extremely difficult for any American dyestuff manufacturing concern, whose policies prevent the employment of this method of obtaining business, from making any considerable headway in this market. Considerable quantities of American-made colors are sold both in Mexico and South America at the present time, but in nearly all instances they pass through second hands who are not overscrupulous as to their commercial ethics.

It is obvious that, with the potential dyestuff manufacturing capacity of American plants far exceeding normal domestic consumption, some foreign outlet must be found or greatly increased domestic consumption stimulated if these plants are to operate profitably. The foreign market would seem to be the most logical place to look for this increased consumption. To say, however, that the "will to export" is all that is required to succeed in this direction is a grave misstatement of the facts. If it were possible for our domestic manufacturers so easily to achieve success in the export field they would be proven guilty of the grossest misrepresentation to the various legislative committees before whom they have plead for protection from foreign assaults against our domestic markets.

Generally speaking, it is obvious that if we cannot meet German competition on an even basis at home we cannot possibly hope to do so abroad. This does not mean that efforts to capture the foreign markets should be abandoned as hopeless, but it does mean that these efforts will be surrounded with almost insuperable difficulties and that only the exercise of the greatest ingenuity and untiring effort will make the permanent possession of any portion of them possible.

A really substantial portion of the foreign markets of the world would prove to be the salvation of our domestic dyestuff manufacturing industry. The attainment of this goal, however, is something which only the most intelligent and energetic study of the problem and the closest co-operation of all parties at interest can hope to make an accomplished fact.

T. C.'S COLUMN

THE SHADE CARD

OF all the dye makers' mediums of distribution, the shade card is perhaps the most effective. There is certainly nothing handier than a concise shade card, not too large, but carrying a full line of colors for some particular fiber or kind of fabric. The one that is arranged most conveniently is the one that will be used, and is the card most likely to serve as the basis for requisitions to the P. A. Several manufacturers have issued such cards and for their purpose one can scarcely find anything better.

Another valuable type consists of cards, roughly 8½ by 11, one for each dye, suitable to place in a large binder or to fit a standard letter file. Such a card can carry almost any amount of data and such a file becomes a storehouse of dye information. It has more value than the first as a reference for new problems but is not as convenient for routine work. These two cover the main uses for color cards, a permanent expansible file, and a smaller card in book form for daily use.

Including prewar editions, we find a great many very useful and some truly wonderful cards that have been prepared with great patience and expense and that are valuable additions to any dyer's library. There is also as equally wonderful variety of misfits—some are short and fat, some are long and slim, some are wide and some are narrow. Some appear to be experiments, others to be novelties, and others seem to be made up on whatever system first came into the designer's head.

Here are a few dimensions from a random selection from half a dozen or more American and foreign dye manufacturers:

3¾ x 6¾	5 x 8	6 x 8	7 x 9½
4 x 7½	5 x 9	6 x 8½	7 x 10
4 x 8	5 x 9½	6 x 9	7½ x 10½
4½ x 7	5½ x 9	6 x 9½	9½ x 11½
4½ x 8½		6 x 10	10½ x 11½

You have no doubt tried to arrange your collection neatly on a shelf or pack it away in a drawer or file, but there are always a few that wouldn't fit in anywhere. The odd shape or size may attract attention, but if it won't go with the rest it is a nuisance rather than a good advertisement.

Let no man attempt to tell the world what it wants for shade cards. There must, however, be preferences, and perhaps if they were expressed we would have more order and system. It seems reasonable that the different firms should issue their material in a fairly uniform manner, for they must realize that the books and cards that are of most practical value are the ones that will in the end do *them* the most good.

The matter of just which kinds to issue is not easy to

decide, but if the seller of dyes should desire to conform to the wishes of dye users, it should not be difficult to get advice. One can even conceive of some formal committee of chemists, dyers, or both offering suggestions or approving some standard forms. Nor do we mean to stop with size, for there are many other things to standardize. The fastness properties should be based on tests common to all companies, that is, on some accepted standard. The manner and strengths of dyeing and kinds of yarn and fabric can be chosen to best serve the average need without sacrificing too much of the manufacturers' individuality.

What the dyer needs is not a lot of fancy and expensive things, but good, plain, sound facts as displayed by dyeings and accompanying information.

We may sometimes feel that technical advertising, as far as it concerns dyes and chemicals, ought to be spruced up a bit and made more interesting. We have at the same time to keep in mind, however, that repeat sales on dyes depend little on the more or less hypothetical but highly lauded *quality*, but very much on chemical and physical properties, which, though often indefinite, are still recognized by the dyer in his results. As in many similar proposals on standardizing, quite a few ideas would have to be changed and some material would be rendered obsolete. Whether protested or not, it would be a step in the right direction, and an ultimate benefit to all concerned. T. C.

INQUIRY DEPARTMENT

E. F. W., Question: We have a 44-inch 6.40 48 square sheeting which is to be backfilled so that the deposit will not come through to the face of the cloth.

Will you kindly give us the formula which will do this work for us and also the method of application, or if you cannot give a formula, any information which you may be able to give would be appreciated by us?

Answer: We would suggest either of the following two formulas:

Formula for Back Filled Medium Sheetings

80 lbs. Corn starch
20 lbs. Potato starch
50 lbs. French chalk
50 lbs. French talc
8 gal. China clay, mixed 4 lbs. to 1 gal.
10 lbs. Cocoanut oil
Blue to shade
Mix 100 gals.
Boil three (3) minutes.

No. 2. Back Filled Low Count Sheetings

100 lbs. Corn starch
15 lbs. Potato starch
15 lbs. Dextrine
50 lbs. French chalk
75 lbs. French talc
25 gal. China clay, mix 4 lbs. to 1 gal.
8 qts. Soluble oil
15 lbs. Cocoanut oil
Blue to shade
Mix 90 gallons
Boil four (4) minutes.

After the size is prepared in accordance with the formula, the goods are run through a back sizing machine in the usual way.

A BOOKLET WELL WORTH READING

The Tide Water Oil Sales Corporation has issued a new booklet which, for beauty of typography, human interest, and instructive, entertaining text, deserves much more space than is possible to devote to its review here. The pages of this booklet represent a collection of twelve folders used in a unique mail campaign among users of lubricating oils and greases. It is entitled "An Unusual History of Petroleum."

Starting with an account of primordial man ten million years ago, its pages carry the reader up through the centuries, treating briefly but in a manner highly interesting, with the romantic history of petroleum, alluding, in turn, to the volcanic destruction of prehistoric civilization; Noah, who caulked his ark with pitch; the Egyptians, who embalmed with petroleum; the oil pioneers of China, Julius Caesar, the Crusaders, the American "medicine men" with their cure-all "rock oil," Colonel E. L. Drake's oil well sixty-five years ago, and the Tide Water pipe line across the mountains of Pennsylvania to Bayonne where is located the company's large refineries.

The text on each left-hand page is in two columns, one devoted to comments on each folder by a very human character, a certain "Bill," whose witty dialogue adds considerably to the subtle humor sprinkled throughout the book; the second column tells interestingly about some one phase of the refining and distributing of Tide Water products, and on each page offers a different folder or booklet describing the uses of various Tide Water lubricants.

This booklet is well worth reading and worth filing after it has been read; it will be sent upon request to the Tide Water Oil Sales Corporation.

The Sterling Textile Mills, Clinton, Mass., expect to have their new addition, consisting of a one-story building for a modern office, shipping and mail-order department, bleaching and dyeing plant, completed within a short time. The Clinton Concrete Company is the contractor.

Dyestuff Tables

A List of the Principal American-Made Colors with Their Properties and Fastness Characteristics

[NOTE: The publishers of The REPORTER have secured more or less complete data in regard to many of the dyestuffs which are at the present time being manufactured in the United States. As the following material has been brought together from various sources, they realize that errors are quite likely to appear, and it is earnestly requested that any readers who find errors or who are able to give additional information will communicate with the publishers in order that this material may be made as correct, complete and up to date as possible. These tables will appear serially until all colors upon which we have data shall have been covered.]

AMIDO NAPHTHOL RED 6B
(Schultz No. 66)

COMPOSITION: Mono azo.

SPECIALLY SUITABLE FOR: Wool as a level dyeing color.

USUAL METHOD OF DYEING: Acid.

SHADE: Similar to Azo Fuchsine 6B (S-147); bluer and brighter than Azo Carmine (S-673).

SHADE BY GASLIGHT: Reddish.

SOLUBILITY: Good.

LEVEL: Excellent if given a good boiling.

EXHAUSTS: Well.

FASTNESS TO:
- **Acid:** Fast.
- **Alkali:** Ammonia makes the shade yellower.
- **Carbonizing:** Fast.
- **Fulling:** Same as Azo Fuchsines; bleeds badly into white.
- **Ironing:** Good fastness.
- **Light:** Fair; fast enough for ladies' dress goods.
- **Rubbing:** Fast.
- **Steaming:** Fast.
- **Sulphur:** Fast.
- **Washing:** Not fast.
- **Water:** Not fast.

SENSITIVE TO METALS, LIME: Very sensitive to copper, like Azo Fuchsine 6B.

OTHER PROPERTIES: Fairly fast to chrome; turns slightly bluer and duller.

DYED BY OTHER METHODS: Dyes chrome bottom or top chrome; the color is somewhat faster to washing and fulling. Not much change in the shade.

ON UNIONS: Cotton-wool unions dyed neutral: no interest. Dyed acid the cotton is left white. Azo Carmine (S-673) is better.

ON OTHER MATERIALS: Wool-silk unions: The silk is hardly tinted, especially if dyed with acetic or formic acid. Silk: Dyes level, but is not fast to washing or water.

PRINTING: Printed direct on wool with acid this color prints level and is fast to light and washing, and stands after-treatment with chrome.

DISCHARGING: Discharges white with hydrosulphite, but this discharge goes yellow on storing.

COMPETING PRODUCTS: Made in the United States by Central Dyestuff Company; E. I. du Pont de Nemours & Co.; United States Color & Chemical Company; Grasselli Chemical Company; National Aniline & Chemical Company; Newport Chemical Works; Passaic Color Corporation; Amalgamated Dyestuff & Chemical Works; Garfield Aniline Works.

CHROMOTROPE 6B
(Schultz No. 67)

COMPOSITION: Mono azo.

SPECIALLY SUITABLE FOR: Wool.

USUAL METHOD OF DYEING: Acid and top chrome.

SHADE: Direct: a violet red; top chrome: a greenish black.

SHADE BY GASLIGHT: No change.

LEVEL: In blacks only.

FASTNESS TO:
- **Acid:** Fast.
- **Alkali:** Not fast.
- **Carbonizing:** Not fast.
- **Fulling:** Not fast.
- **Light:** Does not change noticeably on fourteen days' exposure.
- **Potting:** Not fast.
- **Rubbing:** Fast.
- **Steaming:** No change in shade in dry steaming.
- **Washing:** Not fast.
- **Water:** Not fast.

ON OTHER MATERIALS: Cotton-effect threads are left clear; silk-effect threads are stained, but not as deep as the wool.

COMPETING PRODUCTS: Made in the United States by Amalgamated Dye & Chemical Works (Selling Agents, John Campbell & Co.); National Aniline & Chemical Company; Newport Chemical Works.

BRILLIANT ORANGE O
(Schultz No. 70)

COMPOSITION: Mono azo.

SPECIALLY SUITABLE FOR: Wool.

USUAL METHOD OF DYEING: Acid or neutral.

SHADE: Yellow shade orange.

SOLUBILITY: Good.

LEVEL: Suitable in medium shades.

FASTNESS TO:
- **Carbonizing:** Fast.
- **Fulling:** Not fast; bleeds into white.

Light: Stands fourteen days' exposure without noticeable change.
Potting: Not fast.
Rubbing: Fast.
Steaming: Fast to dry steaming.
Sulphur: Changes shade, going lighter, and bleeds slightly.
Washing: Not fast.
Water: Not fast.

OTHER PROPERTIES: Mainly used in compound shades of brown.

ON UNIONS: Wool-silk: Both fibers are dyed nearly to the same depth.

ON OTHER MATERIALS: White cotton-effect threads are stained.

DISCHARGING: Hydrosulphite discharges the color.

COMPETING PRODUCTS: Made in the United States by Sherwin-Williams Company.

HELIO FAST RED
(Schultz No. 73)

COMPOSITION: Insoluble azo dye.

SPECIALLY SUITABLE FOR: Lakes.

SHADE: Bright, lively red.

REMARKS: This color shows a very good fastness to light; even better than lakes produced with the alizarine dyestuffs. It is absolutely fast to water, alkali and acids, and is insoluble in oil and spirits. Because of its fastness to alkali it is adapted for the manufacture of lime colors and for the dyeing of cement.

COMPETING PRODUCTS: Made in the United States by the Siegle Corporation of America.

XYLIDINE ORANGE 2R
(Schultz No. 79)

COMPOSITION: Mono azo.

SPECIALLY SUITABLE FOR: Wool.

USUAL METHOD OF DYEING: Glauber salt and sulphuric acid.

SHADE: Orange.

SOLUBILITY: Not very good.

LEVEL: Fairly level.

FASTNESS TO:
Acid: Fairly fast.
Carbonizing: Fairly fast.
Fulling: Not fast; bleeds into white wool and white cotton.
Light: Slight change in shade on fourteen days' exposure.
Perspiration: Fast.
Potting: Not fast; bleeds off badly.
Rubbing: Fast.
Street Dirt: Fast.
Sulphur: Fairly fast; no change in shade, but bleeds slightly.
Washing: Bleeds off badly.
Water: Bleeds.

DYED BY OTHER METHODS: Stands top chroming.

ON UNIONS: Cotton-wool unions: Dyes the wool in a neutral bath; in an acid bath the cotton is tinted.

ON OTHER MATERIALS: Wool-silk unions: Dyed in a sulphuric acid bath, both fibers are dyed equally. Silk: Dyed in a bath of boiled-off liquor broken with sulphuric acid. Jute: Dyed with alum.

DISCHARGING: Discharges white with hydrosulphite.

COMPETING PRODUCTS: Made in the United States by Central Specialty Company; Sherwin-Williams Company; E. I. du Pont de Nemours & Co.; Amalgamated Dyestuff & Chemical Works.

PONCEAU 2R
(Schultz No. 82)

COMPOSITION: Mono azo.

SPECIALLY SUITABLE FOR: Wool.

USUAL METHOD OF DYEING: Acid.

SHADE: Scarlet for red flannel.

SHADE BY GASLIGHT: No change.

SOLUBILITY: Good.

LEVEL: Satisfactory as a self-color.

EXHAUSTS: Well.

FASTNESS TO:
Acid: Fast.
Carbonizing: Fast.
Fulling: Fast enough for flannel.
Ironing: Fast.
Light: Fast to fourteen days' exposure.
Perspiration: Fast.
Steaming: Good.
Street Dirt: Fast.
Sulphur: Good.
Washing: Fairly fast.
Water: Fast.
Acid Milling: This is one of the best scarlets for this purpose.

ON UNIONS: Cotton-silk: Dyes acid; the cotton is hardly tinted. Wool-silk with acetic: The silk is very light.

ON OTHER MATERIALS: Silk: Dyes in boiled-off liquor and sulphuric acid. Jute: Suitable when dyed with alum. Suitable for dissolving in a shellac borax solution. Gives red shades on chrome-tanned and bark-tanned leather.

PRINTING: Good for printing on slubbing.

DISCHARGING: The color is discharged with zinc dust to a white.

COMPETING PRODUCTS: Made in the United States by Amalgamated Dye & Chemical Works (Selling Agents, John Campbell & Co.); Calco Chemical Company; Central Dyestuff Company; Cincinnati Chemical Works; Heller & Merz Company; National Aniline & Chemical Company; Newport Chemical Works; Sherwin-Williams Company.

THE GARVAN DINNER

The testimonial dinner to Francis P. Garvan, held in the Waldorf-Astoria Hotel on Saturdy evening, April 25, was attended by nearly 700 guests, the large majority of whom were connected with some division of the American chemical industry. These men and women were assembled to pay tribute to Mr. Garvan and to show their gratitude toward the man who took over and developed the Chemical Foundation, which has proven of such limitless benefit to our chemical industry.

Among the societies and organizations participating in honoring Francis P. Garvan were the American Chemical Society, the American Electrochemical Society, the American Institute of Chemical Engineers, the American Association of Textile Chemists and Colorists, the Chemists' Club, the Manufacturing Chemists' Association, the Salesmen's Association of the Chemical Industry and the Synthetic Organic Chemical Manufacturers' Association.

Men prominent in the American chemical industry delivered addresses which were for the most part designed to instill into those present an even greater appreciation of Mr. Garvan's part in our chemical industry's development by setting forth the importance of that industry to the country's welfare.

Dr. Edgar F. Smith, former president of the American Chemical Society, acted as toastmaster. Dr. George David Stewart spoke on "Chemistry and Health," and explained how chemistry, "the master science," plays its important role in combating disease and protecting life, and described briefly the features and properties of such vitally important medical contributions as Insulin, Salvarsan, anti-toxins and cocaine.

Elon H. Hooker, president of the Manufacturing Chemists' Association, chose for his subject "Chemistry and Wealth," treating of the American problem in chemistry, the importance to us of foreign trade in developing domestic industries, and the protection of our natural and economic wealth by the powers inherent in chemistry.

Dr. L. H. Baekeland, president of the American Chemical Society, delivered a short, inspiring address noteworthy for its wisdom, born of long experience, and a broad, unbiased viewpoint of the chemical industry in relation to national progress.

Brigadier-General Amos A. Fries spoke on "Chemistry and National Defense." His address is published below. When General Fries had concluded, Dr. Charles H. Herty, president of the Synthetic Organic Chemical Manufacturers' Association, presented Mr. Garvan with a magnificent silver loving cup, a contribution of all those present, in behalf of the American chemical industry. After reading a number of telegrams and communications of tribute from those unable to be present, Dr. Herty made the presentation as follows:

"Now, I have one other piece of writing, and this time I have asked a friend, who does not wield a pen but something sharper than a pen, to write me a little message that I could give to Mr. Garvan in behalf of all of you good friends who are assembled here. I am going to read this message just as he has written it (reading inscription on loving cup to be presented to Mr. Garvan):

" 'Presented to Hon. Francis Patrick Garvan, with grateful appreciation of his unselfish devotion toward and untiring efforts in behalf of the advancement of chemical education, research and industry in the United States of America, by the Chemical Societies of America. April 26, 1924.' "

Francis P. Garvan's response to this tribute of praise is printed herewith, following General Fries' address.

CHEMISTRY AND NATIONAL DEFENSE*

By Brigadier-General Amos A. Fries
Chief of the Chemical Warfare Division, U. S. Army

We are all acquainted with a certain notorious phrase to the effect that in case of need a million men would spring up overnight. Before the World War most Americans had the idea that great chemical industries, dye plants and medicine factories could grow overnight into full production. The war was a terrible—almost disastrous—disillusionment.

By marshalling all the chemists, all the near-chemical plants and all the chemical laboratories in the civilized world outside of Germany and Austria, the Allies succeeded after four years in winning the war by the skin of their teeth, but only after an expenditure of money that would have made Croesus die of envy at night.

To-day we know better. And though there are haltings here and there, we are going on developing our chemical industries and chemical knowledge until we are independent in that science of the whole world.

Let us write it in letters of fire that can never die, "Without chemistry no nation can be prepared."

A nation's food, a nation's railroads and steamships, a nation's clothing, its medicines, its automobiles and trucks—yes, even its guns, as well as all its ammunition—depend on chemistry.

Germany would have collapsed in the fall of 1915, a ridiculous figure of a bully whose bluff is called, had not her chemists and chemical industries breathed the breath of life into a dying effort.

Her fertilizer, needed to grow food; her powders and explosives, her war gases and gas masks, her synthetic rubber, her paper cloth, and a hundred other articles consumed in war as water tumblers over Niagara—all, all depended on chemistry.

Did German genius produce all these things with the waving of a fairy's wand?

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*An address delivered at the testimonial dinner to Francis P. Garvan, April 25, at the Waldorf-Astoria Hotel.

Our honored guest, Francis P. Garvan, can give you the answer in the 5,000 patents taken over by the Chemical Foundation. Those 5,000 patents were the result of infinite toil and effort by thousands of chemists and engineers working on a careful plan for forty years.

German organization, German midnight oil and German willingness to work fourteen hours a day for more than a generation are what gave her control of the chemical industry of the world in 1914.

Germany it was that made out of that ugly duckling of chemistry—coal tar—after a third of a century of steady toil, the beautiful myriad-colored swan that is chemistry to-day.

I came here neither to praise nor yet to bury German genius. I cite German achievements as pillars of fire to guide us in the future. What Germany has done—yes, what any nation has done or may do—America can do if she be only wise.

But only in fairy tales are cities built and worlds conquered by the waving of a wand.

In real life achievement and hard work ever go hand in hand.

Neglect always brings sorrow in its train. Let us consider just one chemical example of the World War—mustard gas. That slow boiling liquid was discovered and its various qualities very completely worked out in 1886. Its discovery was an accident—and yet not all an accident. Back of that accident lay years of careful research by the chemist, years spent in heating and cooling, in mixing and separating chemical upon chemical. Here he found a color, there he unearthed a high explosive; yesterday he stumbled onto a wonderful medicine to bless the world, and to-day he found a war gas. The good and the bad inextricably mixed. Ever and always the chemist, like the psychologist, finds Dr. Jekylls and Mr. Hydes in every ounce of coal tar. A few years went by after mustard gas was discovered, and we find the German making indigo from coal tar. And suddenly we note that his method of making indigo is almost exactly that for making mustard gas. A change of materials and manipulation in one of four reactions, and lo! instead of indigo, there is the innocent looking oily mustard gas. You look at it, smell it, breathe it. It has a dark amber color, it reminds you of mustard, and it causes no discomfort or uneasy sensation.

Tens of thousands of French, British and American boys learned to their lifelong sorrow that the mild sensations of mustard gas were like the purring of the tiger before he springs upon his prey. And when he learned the power of mustard gas, the American boy asked, with the authority of one who is about to die: Why don't you send us mustard gas to fire back at the German, so he may taste of the fires of torment?

And what could we answer? We threw up our hands and said: We can't make it. And he said: Why can't you make it? Aren't your chemists as able as the German chemists? And we answered: We can't make it because we haven't made any indigo. And we never did make it by the German indigo dye method.

It took a Sir William Pope, of England, to work up a new chemical method of making mustard gas in a test tube. And then it took a Usine du Rhone in France, a Levenstein in England, and scores of Americans to work out how to make mustard gas on a large scale by a method we could develop without having to first learn to make indigo.

And the fullness of summer passed into the calm of autumn. Autumn calmness changed to winter's cold and snows. Spring came, and the terrific German attacks of the early summer of 1918 made freedom fear the day of doom had come.

And still no mustard gas for the Allies. Not until the anniversary of our own Declaration of Independence did we succeed in making the German fear the terror he had unleashed one year before.

The winning of the war was thus delayed, and it comes right back to this problem: We did not have a chemical industry, and one of the reasons why we did not were those patents which the Chemical Foundation took hold of and made available to American genius and American wealth and American energy; and because it has that fight to make and must continue that lawful work of the country, that the Chemical Foundation, under the leadership of Mr. Garvan, has been going through, and it is one of the things that I have appreciated immensely.

Remember this, that every great chemical plant is more of an advantage to this country in the future than the greatest battery of 16-inch guns ever built. You cannot make these factories overnight. You have got to build them up; and then, when you have got your trained chemists, and trained worker in overalls to help him, we can take those plants and tell you how to make this gas or that gas.

I am going to digress here just a little and cover a point mentioned by one of the other speakers, and say that none of these great powerful gases have been discovered since the World War started. They were all discovered before, in the laboratories of our industries, of our chemical houses, in colleges and among individual investigators. So closely allied are our medicines and our poison gases and your high explosives and your perfumes that the wisest of your chemists to-day cannot tell what he is going to get when he starts out by these tests and when you get to 205 Bayer, which has been spoken of to-night, the new cure for sleeping sickness, the first word that came from England was, the Germans were trying to patent Lycite, the famous gas Lycite, in England. It closely resembles Lycite and an arsenic compound; that is, an arsenic and acetylene compound. That relation is so close that it is always going to exist, and then the chemical workers are going to discover them; and whether it is to be a medicine or a poison, depends on whether you take the right dose or too big a dose; and in that same line we have been experimenting now for two years steadily in treating colds and laryngitis and

bronchitis and whooping cough with chlorine, and we are getting about 75 per cent cures, in the Pathological Section in the Chemical Warfare Service, and we are studying the effects on human beings.

Another thing they have recently developed is the method of treating phosgene gases whereby a person—or more particularly in this case dogs that have been gassed—are getting 60 per cent more phosgene than used to kill them, and they have saved their lives. What would that have meant in the World War? It would have saved hundreds of boys' lives who had phosgene poisoning because we did not know how to handle it.

We would have saved a great deal of the terrible suffering from mustard gas, if we had known that the best treatment in the beginning was bicarbonate of soda, which is the best thing we know to-day, just as you treat any other burn; and it is one of the great problems we are working on now all the time to find out how to defend ourselves against those powerful chemicals and how to cure those that are affected by them, and that information is going back into the industry in time.

The tear gas which some of you experienced to-day is going into the police departments in every city of the land, and it will save the lives of policemen by the scores, enabling them to capture the criminal without shooting him down, or the depraved and insane; and to disperse the highly-nervous mob that does not know what it is doing, without doing damage to anybody; and it will make a laughing-stock of those who assemble in unlawful places.

That is the sort of work we are doing. In doing that, however, we are keeping our country prepared. We are not preparing for war, but for peace.

We have the greatest country, the richest country, the happiest, and the most contented people that the world has ever seen, with less of grinding poverty than ever existed in the world. Are you afraid to arm yourself for fear that you will go out and prey on your neighbor? Am I? No, we are not. It is absurd to think of it; but we must be powerful enough to defend ourselves, and if we are afraid that we will go out and jump on somebody, because we carry a pistol, what can we expect of the other fellow if we have wealth that excites cupidity that no wealth ever excited before?

We have to look at these things with sanity in economic life. We are simply taking the work of the chemist and looking to see how somebody might work on that, and protect ourselves against it. That is only common sense, the thing that we have to keep up; and I want to say here that we in the Chemical Warfare Service can appreciate to the uttermost the tremendous loyal support the American chemical profession has given us. They gave it to us in the war. They are giving it just as unstintingly to-day, and the security of this nation is greater by one hundred times now, than it ever was during the work of the chemists and the chemical manufacturers who are making available those materials that we will have to use in war; whether it is to increase your products on land for food supplies; whether it is making your steels and your other fine metals, or your powders and high explosives. Even yet we do not have in our country the power to produce nitrogen that makes the nitric acid that is the necessary base not only of the fertilizers, but all your powders and your high explosives; and until we get that, we are dependent on foreign countries for one of the most vital elements of national defense and national prosperity. I thank you.

RESPONSE BY HON. FRANCIS P. GARVAN*

Whatever I may have done to deserve your fulsome praise was only done because my experience bore in upon me an appreciation of the relation which you, as representatives of the great science of chemistry, bore to our country's health and our country's prosperity and our country's security. That realization came from German documents. It came from interviews with German representatives. It came from the inspection of the German correspondence which they left here in the organizations planted throughout this country to prevent you from achieving ever your chemical independence and to allow her to continue the masterful position which she held in the world.

And therefore I am only one of one hundred and ten million people who would become as enthusiastic and as energetic and as absorbed in helping you, if you will do your part and make them realize the truths of the relation of chemistry to the life of the nation.

Happily now six years have gone by since this fight commenced, and we are able to foresee success. The great tragedy of science has happened—the slaying of that beautiful and German-built hypothesis that she alone had the men capable of research, had the men capable of the concentrating effort to build up the great chemical industry. That beautiful hypothesis has been slain by the ugly fact of accomplishment.

To-day we are chemically independent, and in twenty years we will chemically lead the world. (Applause.)

That progress has been made not only in the industries but in our educational institutions. Over fifty millions of dollars has been given by appreciative American citizens to the development of laboratories and equipment in the universities of America during the past five years: $3,000,000 at Yale; a million and a half at Cornell; $500,000 at Dartmouth; $250,000 at Tufts; a million dollars at Boston College; three million dollars at the University of Illinois; four million dollars at the University of California. All over the land the people are awakening and are beginning to furnish you with the supplies of men and brains to continue the great work you have begun. Within ten years, as we foresee it now, over $100,000,000 will be

*Speech by Francis P. Garvan responding to the tributes tendered him at the testimonial dinner in the Waldorf-Astoria Hotel.

expended in chemical equipment for education throughout this country.

Therefore it looks to me as if we were going to formally and truly establish chemistry in this country. At this moment we think of success, the moment to me which seems necessary that the chemsits should take stock of their ideals and their purposes, and in taking stock of their ideals they have only to look back on the great cult of great men and thinkers who have preceded them in their profession; men great not only in mind but great in heart; and what better is there for us to do than to look back into the lives of some of those great men, not only to study their scientific accomplishments but to study their character and their heart and purpose and ideals in life and see if we cannot find out what was the motive force which made them so spiritually great?

I think I have found it, and I will only give you a few instances from which I deduce my finding. Lister, to whom we all owe so much, was one day operating on the elbow of a little child, an operation which only was possible after his discovery. The little child bravely and splendidly bore the pain, and when the doctors lifted her afterward she dropped her doll, and it appears that the doll's knee had become disconnected and the sawdust was coming out; and the great Lister sat down and with his needle sewed up the doll's knee and handed it to the pleased and relieved child.

Huxley said: "Think only of the new-born in all that thou doest." Pasteur said that he had derived all his philosophy at the bedside of his dyeing child.

Each one of these scientists was filled with expression of his working for the love of humanity, working for posterity. What did it all mean? It meant that the scientist was working for children, and for the children of children's children. It meant that the motto of his life was, "And a little child shall lead them"; and that is what I want to propose as the purpose and the ideal of American chemistry, as it goes on to illuminate and lead the world, and that is the profession and the ideal which we only ask, we who are not chemists. We who are not the great healers and the relievers of the sick, we can only contribute and encourage.

All we ask is that you tell us that we may appreciate. All we ask is that we may have an opportunity to sustain and defend and support you in the march of progress. All we ask is, as we asked when the 27th Regiment came back and marched up Fifth Avenue—all we asked that day was the right to stand on the walk and cheer.

And all we ask in your march for humanity with that motto is the same right with the little boy who went into the New York hospital in coma and came out two weeks later cured, from a chemist's discovery—all we ask is the right to be standing on the sidewalk and feel that we have done something to deserve the right to cry with joy.

Gentlemen, you owe no obligation to me. Meeting the men whom I have met, and opening the chapters of your great history in the past, has paid me more than I can ever discharge; but I pledge you that if I have devoted any time and thought and attention in the past it is but a tithe to what I hope the future holds an opportunity for me to give in the future. (Great applause, the whole audience rising.)

AMERICAN CHEMICAL SOCIETY DYE DIVISION ABSTRACTS

(*Continued from page 290*)

Researches on Thiazoles—V. A New Group of Dyes from Poison Gases, Through the 2-Aminothiazoles as Intermediates—The Preparation of Thiazole Dyes of Doebner Violet Type

M. T. Bogert and M. Chertcoff

No more powerful lachrymators were discovered during the war than the halogenated ketones of $RCOCH_2Cl$ type. By the action of thioureas upon such compounds, 2-aminothiazoles result, a fact which was discovered many years ago. It has now been found that such aminothiazoles can be condensed with aromatic aldehydes, in presence of HCl, to aryldithiazylmethanes, analogous to the production of triphenylmethane derivatives from benzaldehyde and arylamines. By oxidation with PbO_2 and HCl, these aryldithiazylmethanes yield the corresponding carbinols, the monoacid salts of which are green dyes.

Among the many interesting features of this investigation are the following:

1. Traumann (Ann., 249, 50; 1888) found it impossible to condense a dimethyl derivative of 2-aminothiazole with benzaldehyde and expressed the opinion that such condensations in the thiazole field were impossible.

2. The nuclear hydrogens removed in this condensation are those in Position 5, which is the equivalent of the para position with reference to the amino groups present—i. e., exactly where such attachment of the benzaldehyde residue was to have been expected.

3. Although the amino groups are unsubstituted in the dyes prepared, and these dyes are therefore of Doebner Violet type, they color wool or silk a green resembling that produced by Malachite Green, but bluer.

4. In tinctorial power and fastness, the dyes so far prepared are inferior to Malachite Green.

The Influence of Groups Containing Sulphur in the Meta Position on the Color of Azo Dyes

G. D. Palmer, Jr., and E. Emmet Reid

In previous studies by Waldron and Reid (J. Am. Chem. Soc., 45, 2399; 1923) the marked bathochromic effect of sulphur in the para position has been shown. The effects in the ortho and meta position are less pronounced and less regular. A number of new inter-

mediates and dyes have been prepared so as to contrast the effect of the methyl, methoxyl, methyl-mercapto and methyl-sulphone groups in the meta position. Illustrated by dyed skeins.

The Influence of Groups Containing Sulphur on the Colors of Triphenyl-Methane Dyes

H. S. Holt and E. Emmet Reid

A number of dyes of the Malachite Green class have been made having methyl, methoxyl and methyl-mercapto groups in the ortho and para positions. Notable differences in color are observed, particularly when these groups are in the para position. Illustrated by dyed skeins. In like manner a number of substituted phenol-phthaleins have been prepared containing the above-mentioned groups. All of these are indicators which change color at nearly the same acidity. The colors are markedly different. Illustrated by experiments with the indicators.

Effect of Hydrogen-Ion Concentration on the Adsorption of Dyes by Gels

C. E. White, R. E. Marker and Neil E. Gordon

The adsorption of Orange II, Metanil Yellow, Methylene Blue and Crystal Violet by ferric oxide, silica and aluminum gels was determined at different hydrogen-ion concentrations. It was found that there was a marked change of adsorption under the varying hydrogen-ion concentrations, and at certain concentrations there was definite evidence of chemical reactions. The adsorptions were repeated while in the presence of certain inorganic salts. These salts in some cases decreased the adsorption, while in other cases the adsorption of the dyes was very greatly increased.

The Preparation of 2-Amino-Anthraquinone from 2-Methyl-Anthraquinone

Max Phillips

The 2-methyl-anthraquinone was oxidized with chromic acid to 2-carboxy-anthraquinone (yield 90-97 per cent of theory). This was converted into the corresponding acid amide (yield 77.5 per cent of theory). The acid amide when subjected to the action of sodium hypochlorite or sodium hypobromite (Hofmann's Reaction) yielded 2-amino-anthraquinone (yield 57 per cent of theory).

The Preparation of Methyl-Isopropyl-Anthraquinone

Max Phillips

Phthalic anhydride was condensed with p-cymene in the presence of Al_2Cl_6 yielding cuminoyl-benzoic acid (M. P. 124 deg. Cent. corr.). This acid when treated with sulphuric acid was converted into methyl-isopropyl-anthraquinone (M. P. 111.2 deg. Cent. corr.). On reduction with zinc dust and ammonia this anthraquinone was reduced to methyl-isopropyl-anthracene (M. P. of picrate = 131 deg. Cent. corr.). When nitrated with HNO_3 (d = 1.4) the methyl-isopropyl-anthraquinone was converted into a dinitro derivative (M. P. 232 deg. Cent. decomp.).

Physical Constants of Intermediates for Dyes—I. Methyl-Anthracene, Acetic Anhydride and Diethyl-Aniline

C. A. Nelson and H. Wales

This paper is the first of a series to be published by the authors on physical constants, such as melting point, freezing point, boiling point, vapor pressures at different temperatures, and, in some cases, some of the optical properties of a number of intermediates used in dye manufacture. This work is to be extended not only to the pure compounds but also to their commoner commercial mixtures. This paper contains, besides an introduction to the series of papers that will follow, the methods of preparation and purification of and the physical constants thus far obtained on methyl-anthracene, acetic anhydride and diethylaniline. The method and apparatus used in determining vapor pressures are the same as were used by Nelson and Senseman (J. Ind. Eng. Chem., 14; 1922; 58) in determining the vapor pressures of naphthalene, anthracene, etc. The methods of obtaining melting points and freezing points are described wherever it is necessary to modify the customary methods of obtaining these constants.

Elimination of Soluble Tar from Sulphonation Masses

J. A. Ambler and D. F. J. Lynch

The tarry material produced in high temperature sulphonations seems to consist of soluble sulphonic acids which are not removed by the usual processes of clarification. It has been found that when the tarry sulphonation mass, properly diluted with water, is subjected to the action of live steam, the soluble tarry material is converted into an insoluble form which is easily removed by clarifying agents. This is apparently a hydrolysis of tar sulphonic acids. The method is applicable only to those sulphonation masses in which the sulphonic acids sought are not of themselves hydrolyzed at the temperature of the steam used.

The Influence of Constitutional Variation Upon the Color of the Alkali Salts of Certain Halogenated Derivatives of Fluorescein and Their Stability to the Hydrogen Ion

Walter C. Holmes

1. In the instance of substitution within the phthalic anhydride residue of fluorescein, the nature of the halogen concerned exerts a small but distinct influence upon the displacement of the absorption maximum.

2. The effect of substitution in either residue is not

a constant, but is increased by substitution in the other residue.

3. The stability of the alkali salts to acidity in aqueous solution increases with substitution within the resorcin residues and decreases with substitution within the phthalic anhydride residue.

4. The stability of the alkali salts to acidity decreases with increasing atomic weight of the halogen substituents.

The Spectrophotometric Determination of Hydrogen-Ion Concentrations and of the Approximate Apparent Dissociation Constants of Indicators. II. Thymolsulfonphthalein

Walter C. Holmes and E. F. Snyder

1. The dissociation of the indicator throughout its alkaline and acid ranges has been investigated by means of the spectrophotometer.

2. Spectrophotometric constants (ratios) are supplied to serve in the evaluation of solutions of unknown hydrogen-ion concentrations.

The Influence of Constitutional Variation in Dyes Upon Their Relative Absorption in Aqueous and Alcoholic Solutions

Walter C. Holmes

The relative absorptions of dyes in aqueous and alcoholic solutions do not conform to Kundt's rule, but are primarily dependent upon constitutional factors. The influence of alkyl and aryl substitution at the amino groups, in particular, is clearly defined with dyes of a considerable variety of constitutional types, while the effect of other substitutions is appreciable. The influence of substituents groups is dependent in some measure upon the structure of the parent substance and upon the position in which the substitution occurs.

The Spectrophotometric Identification of Dyes. II. Basic Fuchsins

Walter C. Holmes

An analytical scheme for the identification of the basic fuchsine is outlined and representative data supplied. Identification is based upon the influence of constitutional variation in the dyes upon a series of spectrophotometric constants which define significant differences in the absorption and behavior of the dyes.

The Synthesis of Brilliant Congo R (Vital Red)

Samuel Palkin

The investigation was initiated at the request of Dr. H. M. Evans, of California. The paper comprises:

1. Preparation of purification and methods for the quantitative estimation of intermediates: tolidine, amino R salt and Bronner acid.

2. Preparation and purification of the dye.

3. Reports by Dr. Evans on clinical tests of vital reds from different sources.

The process is based on German patents. Some of the improved features of the revised process are: (a) Separation of a "half-dye" addition product of tetrazotolidine with amino R salt; (b) more careful control of temperature, hydrogen-ion concentration and proportions of reacting constituents; (c) use of an excess (1 mol. excess) of Bronner acid, instead of the theoretical equivalent of 1 mol.; (d) elimination of heat and alkali treatments formerly necessary to render the dye soluble.

Spectrophotometric Analysis Applied to Chromotrope 10B

Wm. D. Appel and Wallace R. Brode

Spectrophotometric measurements of the transmission of light by solutions of a series of commercial samples of the dye Chromotrope 10B are used to determine their strength and shade. The results are compared with the results of titanous chloride titrations of the samples and with practical dyeing tests of them. The spectrophotometric method agrees well with the other methods in the evaluation for strength, but is not sufficiently sensitive to the smaller variations in the quality—i. e., hue and brightness of the samples as shown by the dyeing test. Quantitative spectrophotometric measuresements of reasonably pure α-naphthylamine-azo-chromotropic acid, α-naphthylamine-azo-H acid and α-naphthylamine-azo-1-naphthol-3:6:8- trisulphonic acid are given.

NEW PORTABLE MIXER

The "Lightnin" Portable Mixer illustrated herewith is a device recently put upon the market which ought to prove of very considerable service to all handlers of solutions of thin pastes which will require thorough mixing. It consists of a small motor which drives a propeller rod which is adjustable in length and which may be attached at any desired angle by means of an ad-

justable clamp which can be readily transported from one part of the plant to another and quickly attached to any barrel, kettle or tub in which a mixing operation is being carried out. An extension cord permits its attachment to any convenient electric outlet. It is available in four sizes designed to operate for capacities from 5 gallons to 1,500 gallons. The name of the manufacturer and further data may be obtained by addressing the AMERICAN DYESTUFF REPORTER.

NEWPORT FAST PINK GR EXTRA

Newport Chemical Works announce the production of a color known as Newport Fast Pink GR Extra, which is particularly adapted for cotton printing, as it yields fine strong bluish shades and will discharge to a clean white. It has fair fastness to light and is excellent to washing.

"A DYEING PROBLEM AND HOW I SOLVED IT"

The number of requests for accurate information about dyes and dyeing that come to the office of the publishers of The REPORTER lead them to believe that a series of short articles run under the above heading would prove of practical value to every dyer. That problems arise continually in the dyehouse we know; that such problems are very often solved by the ingenuity or the experience or the "book-knowledge" of some dyer, we also feel sure. To obtain, first hand, a description of these problems and, what is most important, a clear explanation of how they were solved, written by practical men in practical dyers' terms, we are going directly to the dyers themselves.

We will pay $5.00 for every letter we receive which we judge suitable for publication. In judging contributions, literary merit, of course, will not be considered, as we shall properly edit them for publication. Simply tell how your particular problem was encountered, the nature of the dyeing or the bleaching or finishing process that you were using at the time, the kind of fabric upon which the trouble showed, and any other necessary details. Then briefly describe the steps you took to overcome the defect and what final conclusion you arrived at; that is, what facts or information did you discover that was "new to you."

THE STORY OF INDIGO

[*Abstract, Chemistry and Industry; Vol. 43, March, 1924; pages 266-303.*]

THIS story, like that of linen, begins in the early periods of history. The two have been closely associated, but indigo undoubtedly came first, for man used to decorate himself with an extract of woad, which contains indigo, long before he wore linen garments.

Both linen and indigo come from plants and both are prepared by fermenting in water, a natural process, which no doubt taking place by accident in some prehistoric time pointed the way to their use. In fact, the ancient methods are still employed and such improvements as we have are of comparatively very recent origin.

Indigo is and has been for generations the most important single dye.

Away back in 1841 aniline was obtained from indigo and in fact was named from the old Hindustani word "nill" for blue. The natural step after breaking down indigo to aniline was to try to build it up again from aniline. Such attempts led right into the coal tar dye industry.

Finally indigo was made, plants were built, then new methods of making it were discovered and old plants were scrapped. While these earlier methods were successful they were not successful enough. It has often been told how in 1897 a thermometer broke by accident in a vat and the yield jumped from very poor to very good. The contact of a little mercury with the reaction mixture was the key to success and synthetic indigo rapidly developed into its commanding position. While the various technical difficulties were being overcome, natural indigo was suffering a steady decline. The synthetic had all the aid that science could give, while the natural was prepared by methods that were even farther to the other extreme.

The indigo plant is cut in the morning and hauled by bullock cart, perhaps two or three hours' journey, to the factory. There it is packed in vats of slightly warmed water and goes through a complicated fermentation. After one or two more steps the indigo settles out from the water as a blue mud. It is then somewhat purified, filtered and made into small cakes ready for packing.

By this old process certain parts of India had become quite prosperous until the rapid decline caused by the low price of synthetic indigo brought the production down in 1914 to one-twentieth of the high mark of 1896.

As we all remember, the war caused a sudden change and a great demand for natural indigo, the only kind to be had. There was a great rise in price and a rapid increase in acreage. This new opportunity renewed the interest in the indigo plant, and it was seen that success was largely a matter of agriculture. Research financed by a small tax on indigo exports was begun. A study was made of such factors as improved types of plant, a wilt disease, and proper fertilizing. The peculiar con-

clusion was reached that the spent indigo plants from the fermentation are valuable fertilizer, not only for indigo itself but that the future chance of competing with the synthetic will depend as much on the increase in profit from other crops as from a greater yield of indigo. Another of the main opportunities in any further development will be the intensive cultivation of indigo in certain parts of the country which are found to be far more productive than others.

The old style natural indigo was variable in composition as anyone well knows who has tried to analyze it, and it was put up in an inconvenient solid form that required long grinding. During the boom a standardized paste was developed similar in strength to the synthetic, and when shipping from India proved too expensive, the dry indigo was shipped as before and the paste prepared in England.

A claim is made for this paste on which opinions will vary considerably, so we quote from W. A. Davis in Chemistry and Industry, the source of most of these notes: "Natural indigo in this form, possessed considerable advantages over the synthetic indigotin, particularly for woolen and heavy shades—it went much farther than the synthetic material, and gave more agreeable tones and a fine bloom. The color produced by the synthetic product has always lacked 'soul.'"

Attempts at business development went along with the research. For example, there was a pool for selling to maintain reasonable prices. A drive for the China trade was of special promise. It is said that every man, woman and child in China wears an indigo-dyed garment, and before the war this trade was so large that China and Japan together took three-fifths of the German output. This mass production was no doubt a large factor in the cheapening of that product. Reasoning in the same way this trade might react very favorably on the cost of natural indigo. Unfortunately for India, however, even though arrangements were made to supply the paste form so essential to this business, no great share of the trade was obtained.

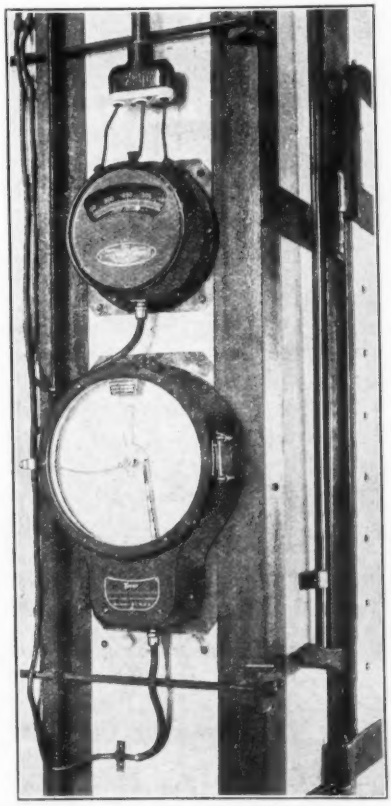
Science brought about the displacement of natural indigo by synthetic. No longer than two or three years ago science again promised to sway the indigo industry, this time in the reverse sense. When circumstances were favorable great progress had been made, but all at once internal troubles interfered with the raising of the plants, and shortage of funds put an end to the essential research. There is no longer support by the government, and the industry is starting to drift back again to its pre-war state.

Through a new system of multiple unit retorts, gas, gasoline, tar dyes, sulphate of ammonia, potash and ammonia will be extracted from lignite near Kelso, Wash. The process also will be used to extract turpentine, creosote and wood alcohol from waste of logging camps and sawmills in Oregon and Washington.

AN ELECTRIC-CONTACT TEMPERATURE CONTROL

Among the catalogues issued by the Taylor Instrument Companies is one describing their electric-contact temperature-control apparatus used in kier boiling, bleaching, dyeing and finishing operations. The movement of these instruments is the same as used in the recording thermometers made by the same firm. Gas-heated or steam-heated apparatus is controlled by means of solenoid valves in connection with the temperature-control apparatus. Temperature is adjusted as follows:

A key is inserted through the opening provided in the side of the case. Turning the key to the right or left raises or lowers respectively the temperature at which the common contact closes the circuit through the minimum and maximum contacts. The difference between the temperature at which a circuit is closed through the common and maximum contacts and the temperature at which a circuit is closed through the



common and minimum contacts is fixed at the factory and remains constant when the control is adjusted. The construction of the case is such that this difference can be changed, however, if necessary, without disconnecting the leads; merely by removing the front of the instrument from its base.

Technical Notes from Foreign Sources

Mercerization of Cellulose

The changes that take place when cellulose fiber is subjected to mercerization and esterification have been studied and determined by the aid of spectrographic examination and the X-ray. This applies to the cotton and the ramie fibers particularly. Certain varieties of artificial silk have also been investigated in the same manner.

It was found that the esterification of ramie fiber and of a number of varieties of artificial silk by acetyl chloride in the presence of glacial acetic acid and pyridine at a temperature of 80 deg. Cent. is a normal heterogeneous process which proceeds from the exterior to the interior of the material accompanied by removal of the cellulose esters. The nitration of cellulose is a typical topochemical reaction occurring in the swollen fiber as in a homegeneous chemical system.

X-ray pictures of ramie or hemp fibers which have been mercerized without tension by sodium hydroxide solution (about 17 per cent concentration) and subsequently washed until free from alkali, exhibit Deybe-Scherrer rings in place of the original point diagrams.

For further details the reader is referred to Berichte, 1924, pages 329-332.

Hair Dye

The process which is described in British Patent No. 209,937 is concerned with a process of making a new dyestuff. This dyestuff is soluble in cold water and is suitable for dyeing human and animal hair. It is prepared by mixing finely powdered para phenylenediamine with a sufficient quantity of a concentrated alkali polysulphide solution to yield a stiff paste. For example, one kilograms of the para phenylenediamine is mixed with 800 cubic centimeters of a solution of 450 grams of potassium polysulphide in 2.4 liters of water. Considerable heat is evolved and the mass solidifies. The product is dissolved in water and mixed with a suitable oxidizing agent; for example, a solution suitable for dyeing American opposum and fox furs blue shades, consists of 120 to 150 cubic centimeters of a 2.3 per cent solution of the product, 300 cubic centimeters of a 3 per cent solution of hydrogen peroxide and a liter of water.

Action of Physical and Chemical Agents on Wool

An interesting article is published in the German textile paper, Textilberichte, volume 4, pages 181 to 188 and 237 to 240, on the effects produced by different chemical and physical agents on the woolen fiber.

The principal physical characteristics of the woolen fiber, namely, its length, resistance to breaking and elasticity, are affected in a large degree by chemical actions that are due to washing, carbonizing, dyeing and treating the material in various ways. The life of a woolen fabric, on the one hand, and the ease of felting on the other, are dependent on the above-mentioned characteristics of the fiber. Hence, the value of a woolen fabric may be judged by the manner in which it behaves before and after the action of these chemical agents. This process of estimating the value of the woolen fabric is not applicable when the problem is concerned with the determination of the resistance to wear and tear of the finished material. In this case the test is made with the aid of friction machines.

In one form of machine the woolen fabric moves back and forth over a dull thin flat piece of metal. In another type of machine the fabric remains stationary and while being stretched on a frame the friction device moves back and forth over it. The wear which is induced in this manner is determined by photographic means. The thickness of the fabric before and after treatment is measured, as well as the resistance offered to penetration. The latter test is made with the aid of a sort of puncher applied to the surface of the fabric under a certain measurable force which can be varied at will.

The resistance of the fabric or of the woolen fiber to elongation or stretching is measured by means of a special device. It is very necessary in making these tests to keep an accurate record of the temperature and of the humidity of the air at which they are carried out. The presence of fatty materials, in more or less large proportions, has a rather marked influence on the constancy of the results.

Waterproofing Process

Cloth is waterproofed, according to British Patent No. 209,138, by spraying, painting or otherwise treating it with artificial aqueous colloidal dispersions of insoluble proofing agents, such as waxes, resins, fatty acids, bituminous substances, etc., with or without the addition of rubber, linseed oil, coloring agents and fillers. Protective colloids, such as sulphonates of oils, salts of fatty acids, gum arabic, gelatin or the like may also be used. It is mentioned that the dispersion process is carried out in the Plauson colloid mill.

For example, 10 pounds of paraffin wax, 10 pounds of water and 13 ounces of gum arabic are beaten in a colloid mill for two minutes at a temperature of 80 deg. Fahr. The gum arabic may be dissolved in the water and treated in the colloid mill, the paraffin wax being added in the molten condition.

Fast Blacks on Textile Fibers

The fabric, which is first impregnated with 2.3 oxynaphthol acid arylide, is treated with diazo compounds of arylazo-1-naphthylamines, which do not contain a sul-

phonic acid group. The arylazo-1-naphthylamines are obtained by the coupling of diazotized aromatic amines, such as aniline, toludine, xylidine, cresidine, anisidine, phenetidine, chlorinated substitution products of these amines, aminoquinolin, naphthylamines, etc., with alpha naphthylamine, alpha aminonaphthol alkyl ethers and the like. In this manner reddish black and bluish black colors are obtained possessed of great fastness to light, chlorine, etc. (German Patent No. 383,903).

PRELIMINARY REPORT, CENSUS OF DYES AND ORGANIC CHEMICALS, 1923

Record Output of Dyes in 1923

The preliminary figures obtained by the United States Tariff Commission for the domestic production of coal-tar dyes indicate an output of about 92,000,000 pounds in 1923 with a value of about $50,000,000. This is a record output in the history of the industry, and exceeds that of 1920, a year of world-wide business activity when the United States had a large export trade in dyes, prior to the reappearance of German dyes in the world's markets.

The 1923 production exceeds by 42 per cent that of 1922. The contrast of the present industry with that of 1914 is apparent when consideration is taken of the output of 1914, which was only 6,619,729 pounds, valued at $2,470,096. The industry of that period consisted largely of assembling plants where intermediates, imported chiefly from Germany, were converted into dyes.

The two factors largely responsible for the increase in 1923, compared with 1922 were: (1) The greater activity of the textile and other dye-consuming industries; (2) the increase in our exports due to the reduced production by the German dye plants during 1923, following the occupation of the Ruhr by the French in the early part of that year.

Large Increase in Indigo

Indigo leads all dyes in the quantity of production, totaling in 1923 about 28,000,000 pounds, compared with 15,850,752 pounds in 1922.

Sulphur Black totaled in 1923 about 16,000,000 pounds, compared with 12,877,649 pounds in the previous year. The output of Direct Black E.W. in 1923 was nearly 7,000,000 pounds, a 30 per cent increase over that of 1922, while the output of Agalma Black 10B was about 2,500,000 pounds, a 50 per cent increase over the previous year.

During 1923 the variety of domestic dyes was increased by the production for the first time of many new dyes. These include dyes of high fastness, the importance of which is increasing as the consumer of dyes more fully appreciates the importance of fast colors. The new dyes comprise colors for the dyeing of silk, wool and cotton. The production of these new dyes of greater complexity represents a creditable advancement in the industry. The industry is still deficient to a slight extent in the production of a limited number of vat and other dyes which are now imported.

The average sales price of dyes during 1923 was $0.54 per pound, compared with $0.60 in 1922 and $1.26 in 1917. The 1923 sales price is a 10 per cent decline from that of 1922. The average sales price of dyes produced in Great Britain during 1922 is reported to be $0.76 per pound compared with the domestic price of $0.60 for the same year.

The production of intermediates in 1923 was about 230,000,000 pounds compared with 165,048,155 pounds made in 1922. The preliminary production figures of some of the leading intermediates was as follows: Aniline oil, over 26,000,000 pounds; H acid, about 3,500,000 pounds; phthalic acid and anhydride, over 2,000,000 pounds; anthraquinone, over 800,000 pounds.

Dye Imports and Exports, 1923

The preliminary figures for the imports of dyes into the United States during 1923 indicate an importation of 3,100,000 pounds, with a value of $3,200,000, as compared with our imports of 3,982,631 pounds valued at $5,243,258 for 1922. Of the total imports of 1923, 47 per cent came from Germany, 28 per cent from Switzerland, 12 per cent from Italy, 6 per cent from France, 4 per cent from the United Kingdom, and 3 per cent from all other countries. Prior to the war about nine-tenths of the dyes consumed in the United States were imported, whereas over nine-tenths of the domestic consumption is now produced in the United States.

The exports of coal-tar dyes during 1923 show a significant increase as compared with those of the previous year, totaling for 1923, 17,924,200 pounds valued at $5,565,267 as against 8,344,187 pounds with a value of $3,996,443 for 1922. The value of exports in 1923 is an 81 per cent decline from 1920 when our exports reached the maximum of $29,823,591. This was a boom year and represented conditions before German dyes had reappeared in the large consuming markets of the world.

The increase in 1923 of exports of dyes may be largely accounted for by the restricted exports of dyes by Germany due to political conditions and the occupation of the Ruhr by the French. The German dye production for 1923 was 25 per cent less than for 1922. In the latter part of 1923 the monthly output of dyes by Germany was steadily increasing, and German dyes are recently reported to be offering sharp competition to the domestic and British dyes in the markets of the Far East.

Norddeutsche Farbwerke A. G., Hamburg, Germany, has been organized with capitalization of 300 milliard marks (a thousand million) to manufacture chemicals and dyestuffs. The new company is backed by Anton Gunther, of Hamburg, the Norddeutsche Chemische Fabrik, of Hamburg, and Jacob Hirsch, of Hamburg.

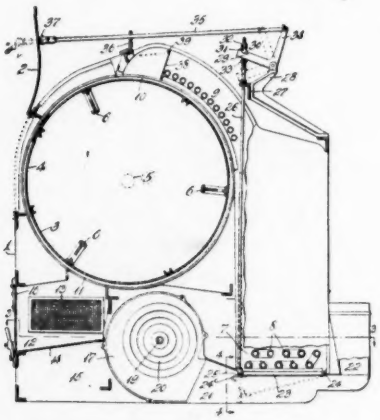
RECENT PATENTS

Drying Apparatus

(1,488,198; March 25)

John J. Dewey, Cincinnati, Ohio, assignor to the American Laundry Machinery Company, Norwood, Ohio, a corporation of Ohio.

Drying apparatus, comprising a casing provided with a drying chamber in its upper portion, a heating chamber behind the drying chamber and a passage leading to an



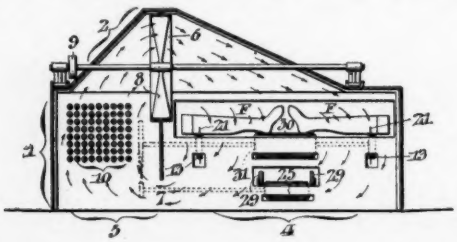
outlet, an air circulating device located beneath the drying chamber and communicating with said passage, a screen chamber located between the drying chamber and device, a movable member arranged in one position to divert a portion of the air to said heating chamber and a portion to the outlet and in another position to close communication between said passage and the heating chamber, and an air inlet to said casing between said device and drying chamber.

Drying Machine

(1,489,223; April 1)

Christian H. Reumann and Harold O. Kaufmann, Philadelphia, Pa., assignors to the Philadelphia Drying Machinery Company, Philadelphia, Pa., a corporation of Pennsylvania.

A drying machine of the character described comprising in combination a drying chamber; means for



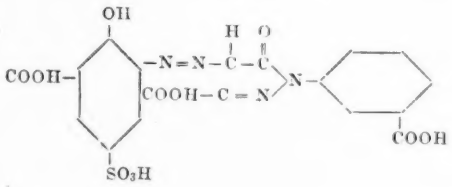
propelling heated air over a lateral course within the drying chamber; a conveyor traversing said drying chamber longitudinally and adapted to sustain, in vertical positions and spaced relation, forms upon which the articles to be dried are mounted, said forms being disposed transversely of the conveyor so as to be aligned in the direction of flow of the circulated air.

Azo Dyestuff Derived from Pyrazolone and Process of Making the Same

(1,489,160; April 1)

August Heinrich Schobel, Basel, Switzerland, assignor to Society of Chemical Industry in Basle, Basel, Switzerland.

As a new product the herein described new azo-dyestuff derived from pyrazolone which corresponds with the formula, forming a reddish-brown powder



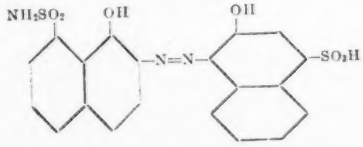
which dissolves in water with orange color, becoming yellow on addition of caustic soda, dissolving in concentrated sulphuric acid to a yellow solution, and yielding, printed on cotton by means of chromium mordants, very bright and fast red orange tints.

Dyeing of Cellulose Acetate, Artificial Silk, Films and the Like

(1,489,814; April 8)

Maurice Ernest Bouvier, Lyon, France, assignor, by mesne assignments, to La Societe pour la Fabrication de la Soie "Rhodiaseta," Paris, France, a corporation of France.

A process for treating cellulose acetate films, silk and the like previous to dyeing, consisting in treating the cellulose acetate with a relatively concentrated solution of neutral salts of alkali metals to which a salt



with an alkaline reaction, adapted to act as an alkali in the saponification of the acetate, is added in quantity less than is required to make a 1 per cent solution.

CHEMICALLY TREATED COTTON LIKE WOOL

Of considerable interest to textile men is a new German chemical process which is said to impart to cotton the appearance, texture and other characteristics of wool. Its promoters, Faberwerke Hoechster, it is reported by H. A. Metz & Co., American selling agents for Hoechst dyes, have been instrumental in erecting a large plant in Germany in which the process is being evolved. As yet, however, the project has not been developed to a state where it can be said to be of use commercially, although H. A. Metz & Co. have received several very interesting cotton-yarn specimens which, from their nature and appearance, promise most satisfying possibilities. If the principle back of this new process is sound and practical it should cause some important changes in cotton fabric manufacture all over the world.

MITCHELL APPOINTED SALES MANAGER FOR CIBA COMPANY

Effective May 1st William E. Mitchell has been appointed sales manager of the Ciba Company. Mr. Mitchell has been associated with this concern as chemist since its incorporation and has gradually extended his responsibilities so that his designation as sales manager is more a change of title than of duties. Mr. Mitchell is widely known in dyestuff circles and his many friends will wish to congratulate him upon this deserved recognition of his services.

DRYSALTERS CLUB ELECTS OFFICERS

The spring meeting of the Drysalters Club of Boston was held at the Copley Plaza Hotel Monday evening, April 21st. After partaking of an excellent dinner the members and guests listened to remarks by several past presidents of the club, beginning with Frederick E. Atteaux, who was the first president.

The nominating committee reported its slate of officers for the ensuing two years, all of whom were unanimously elected as follows: President, Harry R. Davies; vice-president, Sidney R. David; secretary and treasurer, E. A. Bruce; members of the executive committee, John O'Day, J. A. Emmett, W. R. Moorhouse and D. King.

THREE MORE NEW DU PONT PRODUCTS

E. I. du Pont de Nemours & Co. announce Du Pont Phosphine G Conc. as a product similar to the Du Pont Phosphine G which has been on the market for some time. The new phosphine has three times the concentration of the single strength and is especially adaptable for the printing trade, where the higher concentrations are very desirable.

Pontachrome Black PV, a popular brand of dyestuff for the woolen and worsted trade, has also been introduced by this company. It is said to be desirable because of its extreme fastness to potting, and as a self-shade its fastness properties to scouring, light and milling make it commendable. For Vigoureux printing it is also adaptable, and will not gelatinize in concentrations used for this work.

A third new product prepared by the Du Pont company after considerable research work is a highly concentrated type of Sulphur Blue marketed as Sulphogene Direct Blue BRS. Because of its solubility it is adaptable for machine dyeing, yielding a full shade of Navy Blue. It does not require an oxidation before washing, making it especially adaptable for use in circulating machines as well as for piece goods dyeing.

MATHIESON MULTI-UNIT CAR DECISION UPHELD

An application of transportation companies for a rehearing and reargument in the case of the Mathieson multi-unit tank car has been refused by the Interstate Commerce Commission.

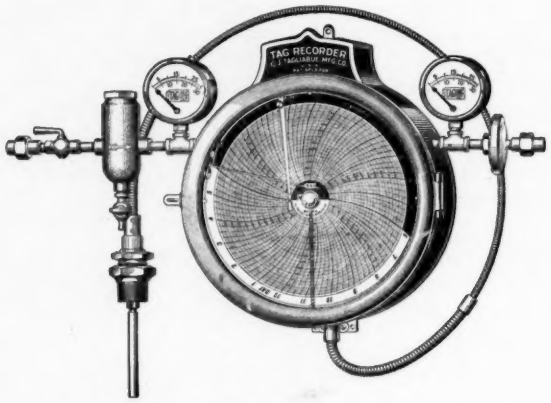
In a decision dated January 31, 1924, the Commission approved the multi-unit car for the shipment of liquid freight rates and privileges as any other tank car. The Commission now refuses to change this ruling.

Over two years previous to this decision when the Mathieson Alkali Works, Inc., placed this specially-designed car in service, the carriers refused to allow it tank car rates and privileges. The Mathieson Company appealed to the Interstate Commerce Commission for removal of this discrimination and up until the recent favorable ruling was forced to pay out a total of over two hundred thousand dollars in excess freight charges in order to continue shipping liquid chlorine in the multi-unit car.

The largest evening class ever graduated from the school, numbering 117 pupils, recently held graduation exercises in Southwick Assembly Hall in the Lowell Textile School, Lowell, Mass. The exercises were attended by a large gathering of relatives, friends and invited guests. President Charles H. Eames was master of ceremonies and Mayor John J. Donovan spoke and delivered the diplomas.

NEW RECORDER-CONTROLLER

The C. J. Tagliabue Manufacturing Company, Brooklyn, N. Y., has added to its instrument line a combined Recorder-Controller. In this design an air-operated temperature controller mechanism and a recording thermometer are mounted in the same case and are actuated by the same thermostatic system. All the structural features of the Tag Recorder, such as the uniformly graduated chart, non-corrodible inverted fountain pen, pen pressure and position adjustment, improved chart holder, are incorporated in this design. An important improvement is the entire elimination of the rubber connections usually employed in instruments of the combined form.



PRODUCTION OF DYES BY GERMAN FACTORIES FOR MONTH OF MARCH, 1924

Group	Classification	March Pounds
I	Alizarine Red	317,376
II	Indigo paste	2,309,792
III	Vat colors except Indanthrene Blue GCD	440,800
IV	Indanthrene Blue GCD	.....
V	Alizarine colors other than red	167,504
VI	Direct colors for cotton	1,410,560
VII	Direct colors for diazotization	255,664
VIII	Acid colors for wool	1,251,872
IX	Chrome colors for wool	414,352
X	Basic colors	458,432
XI	Sulphur colors	3,473,504
XII	Lake colors	229,216
	Total	10,729,072

Factories	March Pounds
Wulfing, Dahl & Co., Barmen	44,080
Aktien-Gesellschaft, Berlin	1,419,376
Kalle & Co., Biebrich	546,592
Carl Jager, Dusseldorf	.....
Cassella & Co., Frankfurt a. M.	1,877,808
Griesheim-Elektron, Griesheim	414,352
M. L. & B., Hoechst	3,729,168
Bayer & Co., Leverkusen	1,992,416
Badische, Ludwigshafen	.....
Leonhardt & Co., Muehlheim	114,608
Weiler-ter Meer, Uerdingen	590,672
Total	10,729,072

In consequence of the failure of the German Dye Cartel to come to an arrangement with the British Dyestuff Corporation all the German dye-making concerns and certain large chemical works will form one huge company with the special object of capturing the foreign markets. It is planned to establish offices in all textile centers and to develop an entirely independent selling organization, instead of employing representatives.

WANTED.—Chemist who is perfectly familiar with manufacture of DIAZINE BLACKS and all the necessary intermediates in its manufacture. Write Box 250, giving all details.

MAN OF WIDE EXPERIENCE IN TEXTILES—laboratory, plant and research—desires to install and operate laboratory to control dyes, chemicals and processes, and develop new ideas. Must satisfy himself of possibilities for saving money and improving processes or product before accepting position. Address Box, 251. American Dyestuff Reporter.

COLOR MATCHER

Color matcher wanted for New York laboratory of large dyestuff manufacturers. A young man who has had previous experience is desired. Address Box 252, American Dyestuff Reporter.

DYESTUFF SALESMAN

A leading dyestuff distributor, with headquarters in Chicago, wants an experienced salesman to cover Middle Western territory handling both imported and domestic colors. In replying give qualifications and experience in detail, together with salary expected. Address Box 256, American Dyestuff Reporter.

WANTED—Chemist thoroughly familiar with the plant manufacture of paratoluylenediamine and its salts. Only one who has made these on a plant scale need apply. Write Box 254, American Dyestuff Reporter.

BARRELS WANTED

WANTED—Empty iron dyestuff barrels. Must be in A-1 condition. State quantity and price. Address Box 255, American Dyestuff Reporter.

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